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Gulf War

Air Power Survey

Summary Report

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by
Thomas A. Keaney
and
Eliot A. Cohen

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**Thomas A. Keaney
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Eliot A. Cohen**

**Washington, D. C.
1993**

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Foreword

From 16 January through 28 February 1991, the United States and its allies conducted one of the most operationally successful wars in history, a conflict in which air operations played a preeminent role. The Gulf War Air Power Survey was commissioned on 22 August 1991 to review all aspects of air warfare in the Persian Gulf for use by the United States Air Force, but it was not to confine itself to discussion of that institution. The Survey has produced reports on planning, the conduct of operations, the effects of the air campaign, command and control, logistics, air base support, space, weapons and tactics, as well as a chronology and a compendium of statistics on the war. It has prepared as well a summary report and some shorter papers and assembled an archive composed of paper, microfilm, and electronic records, all of which have been deposited at the Air Force Historical Research Agency at Maxwell Air Force Base, Alabama. The Survey was just that, an attempt to provide a comprehensive and documented account of the war. It is not a definitive history: that will await the passage of time and the opening of sources (Iraqi records, for example) that were not available to Survey researchers. Nor is it a summary of lessons learned: other organizations, including many within the Air Force, have already done that. Rather, the Survey provides an analytical and evidentiary point of departure for future studies of the air campaign. It concentrates on an analysis of the operational level of war in the belief that this level of warfare is at once one of the most difficult to characterize and one of the most important to understand.

The Survey was directed by Dr. Eliot Cohen of Johns Hopkins University's School of Advanced International Studies and was staffed by a mixture of civilian and military analysts, including retired officers from the Army, Navy, and Marine Corps. It was divided into task forces, most of which were run by civilians working temporarily for the Air Force. The work produced by the Survey was examined by a distinguished review committee, which included scholars, retired general officers from the Air Force, Navy, and Army, as well as former and current senior government officials. Throughout, the Survey strived to conduct its research in a spirit of impartiality and scholarly rigor. Its members had as their standard the observation of Mr. Franklin D'Olier, chairman of the United States Strategic Bombing Survey during and after the second World War:

"We wanted to burn into everybody's souls that fact that the survey's responsibility . . . was to ascertain facts and to seek truth, eliminating completely any preconceived theories or dogmas."

The Survey attempted to create a body of data common to all of the reports. Because one group of researchers compiled this core material while other task forces were researching and drafting other, more narrowly focused studies, it is possible that discrepancies exist among the reports with regard to points of detail. More importantly, authors were given discretion, within the bounds of evidence and plausibility, to interpret events as they saw them. In some cases, task forces came to differing conclusions about particular aspects of this war. Such divergences of view were expected and even desired: the Survey was intended to serve as a point of departure for those who read its reports, and not their analytical terminus.

Acknowledgments

The Survey's members owe a great debt of gratitude to Secretary of the Air Force Donald B. Rice, who conceived of the project, provided it with resources, and set for it the highest standards of independence and objectivity. Many organizations and individuals gave generously of their resources and time to support this effort. Various branches and commands of the Air Force were particularly helpful in providing material for and, in some cases, personnel to conduct the study. The United States Navy, Marine Corps, and Army aided this study in different ways, including the sharing of data pertaining to the air war. A number of the United States' Coalition partners also made available individuals and records that were vital to the Survey's work. Many participants in the war, including senior political officials and officers from all of the Services were willing to speak with the Survey and share their recollections of Desert Shield and Desert Storm. Private students of the Gulf War also made available their knowledge of the crisis and conflict. Wherever possible and appropriate, such assistance has been acknowledged in the text.

The Summary Report is based on the research done by the authors and contributors of the other ten reports of the Gulf War Air Power Survey. The individuals responsible for those reports are listed on pages xi-xiv. We also wish to recognize the work of Mr. Barry D. Watts, who wrote portions of Chapters 3, 4, and 10, and Dr. Wayne W. Thompson, who wrote portions of Chapter 5; both Mr. Watts and Dr. Thompson also provided extensive comments on the entire report. This report also benefitted greatly from the comments and contributions of Mr. Lawrence M. Greenberg, Mr. Richard J. Blanchfield, Col. Emery M. Kiraly, Col. Mark L. Tarpley, Lt. Col. Daniel T. Kuehl, Capt. Jeffrey A. Hodgdon, and Mr. Steven L. Orton. Some graphics and tables are taken from the other reports of the Survey; those produced for this report were done by Mr. Alan P. Heffernan, Mr. Barry D. Watts, and Mr. Lawrence M. Greenberg. Finally, a special word of thanks for the work of the primary typists, Ms. Peggy Kramer and Ms. Cecelia A. French; the editors, Mr. Lawrence J. Paszek, Ms. Anne Predzin, and Mr. Chris Pankow; and layout designers Mr. Michael O. Bowers and Barbara L. Gardien.

The Survey's independence was its reason for being. Each report is the product of the authors who wrote it and does not necessarily represent the views of the Review Committee, the United States Air Force, or the Department of Defense.

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Introduction

This report captures some of the key findings of the ten reports of the Gulf War Air Power Survey (GWAPS). It does not, however, merely offer an executive summary of each report; rather, it asks a number of questions that cut across each of the reports. In all cases, the main reports of the Survey contain far fuller treatment of any given issue than is possible here. Furthermore, the authors of this study could not treat some issues, particularly in the realm of space and intelligence operations, in an unclassified forum such as this.

Chapter 1, What Happened?, gives a brief overview of Desert Shield, the deployment to the Arabian peninsula following Iraq's invasion of Kuwait in August 1990 and a longer account of the Gulf War. It sets a chronological context for the discussions that follow. **Chapter 2, What was the Air Campaign Plan?**, describes the evolution of the air campaign plan that General Schwarzkopf, Commander in Chief Central Command (CINCCENT) authorized for execution on 17 January 1991. **Chapter 3, What did the Air Campaign Accomplish?**, evaluates the effects and effectiveness of the air campaign. **Chapter 4, What was the Role of Intelligence?**, examines the many aspects of intelligence as they related to air operations in the Gulf War, including strategic estimates and bomb damage assessment. **Chapter 5, Who Ran the Air War?**, examines the organizations that orchestrated the air campaign and some of the controversies that emerged, including those centering on the role of the Joint Force Air Component Commander (JFACC) and the lengthy Air Tasking Order (ATO) that coordinated the vast majority of sorties. **Chapter 6, What were Conditions in the Theater?**, briefly treats the political considerations and physical constraints of distance, terrain, weather, and basing structure that shaped the employment of air power in the Gulf. **Chapter 7, What were the Instruments of Air Power?**, covers the role of different air platforms, with particular attention to the unique contributions of the United States. **Chapter 8, What Supported the Air Power?**, discusses some of the other elements of air power, including munitions and logistical support required for the conduct of operations. **Chapter 9, Which Technologies Worked?**, picks five pieces of hardware that reveal distinctive features of the air war. **Chapter 10, Was this a Revolution**

in Warfare?, concludes the report by assessing the extent to which the success of air operations in this war augurs a broader transformation of warfare.

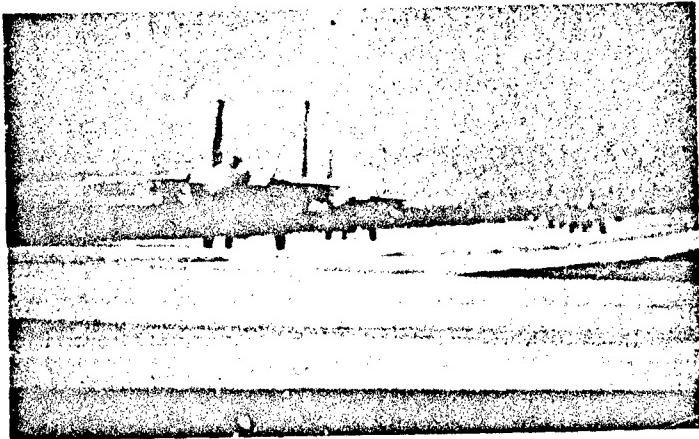
Then-Secretary of the Air Force Donald B. Rice gave the Survey a mandate to examine the widest possible range of issues relating to air power in the Gulf War. In this endeavor the Survey soon became aware that it suffered from both a glut and an insufficiency of source materials. The glut is easily understood. In the age of the personal computer and copying machine, organizations create vast quantities of paper, including incremental modifications of working documents. The professional historians of the Air Force and other Services conducted interviews (subsequently transcribed), collected and microfilmed key papers, and in a few cases directly recorded events as they happened. Subsequently, a host of private and public research organizations conducted studies on virtually every aspect of the war, uncovering further material and producing their own secondary sources. The Survey assembled its own archive of all available material on the Gulf War (see "A Note on Sources" in this report), an archive subsequently shipped to the United States Air Force Historical Research Agency, Maxwell Air Force Base, Alabama.

The insufficiency of information requires some explanation. Much important discussion in this war took place via telephone conversations—rarely did participants, pressed as they were for time, take notes of these conversations. The prevalence of the briefing (rather than the memorandum) as a form of official communication further obscured the historical record. Briefing slides usually consist of "bullets," cryptically phrased assertions or observations that take on meaning only in the context of a discussion—for which notes rarely exist. Such slides usually contain numbers or factual assertions of unknown provenance; very often the Survey began tracking a number down only to find itself caught in a circle of briefings referring to briefings.

Individuals rarely retained electronically recorded information (target databases, for example, or videotapes of bombing runs) in archives; rather, they updated or recorded over computer disks and videotapes. Many of the computer management systems that should have captured adequate information suffered partial or complete breakdowns under the stress of operations on a vast scale and were replaced by ad hoc combina-

tions of computer and paper records that sometimes did not survive the war. Organizations (fighter wings, for example) placed very different emphases on the accurate recording of some of the most important kinds of operational data; the mission reports of many attack sorties, for example, present inadequate information to determine what an aircraft had struck and sometimes even where it had dropped its bombs.

The Survey has reduced the uncertainties surrounding many of these numbers and the events that gave them meaning; it has not eliminated them. It has attempted to frame and answer important questions about the employment of air power in this war, bearing in mind that the issues raised herein have more than a purely historical interest. The Survey will, no doubt, help scholars seeking to improve our understanding of the Gulf War. But it had as its most important audience the young men and women, military and civilian, who will have to consider and create the instruments of American air power in the future. The Survey has endeavored to render for them, in as clear a fashion as time and skill permitted, a comprehensive account of how air power, and above all American air power, shaped the confrontation with Iraq from 2 August 1990 to the end of the Gulf War on 28 February 1991. Should the Survey's reports prove of use to them, they will have served their purpose.



**F-15s from 71st Squadron of 1st Tactical Fighter
Wing (Langley AFB, VA) land at Dhahran on 8 August 1990.**



**General Schwarzkopf and other Coalition leaders
meet with Iraqis at Safwan, Iraq, 3 March 1991.**

What Happened?

Iraq invaded Kuwait before dawn on 2 August 1990. During the next five and one-half months in an operation named Desert Shield, U.S. and Coalition forces poured into the theater to deter further Iraqi aggression and to set the stage for offensive actions. Operation Desert Storm, the combined attack on Iraq, began in the early hours of 17 January 1991 with an independent air campaign and ended on 28 February 1991 after a four-day combined forces ground and air assault. Coalition forces evicted Iraqi forces from Kuwait and destroyed much of Baghdad's military machine. From the outset, U.S. air power was central to the accomplishment of United States' and United Nations' political and military objectives; it enabled the Coalition to deploy its forces and subsequently cripple Iraqi military capabilities, paving the way for Baghdad's defeat on the battlefield. The following pages briefly describe air operations from August 1990 through February 1991, set in their political and military context.

The August 1990 crisis was preceded by increasingly contentious negotiations between Iraq and Kuwait concerning territorial claims and financial obligations. Neither the Gulf states nor the United States, however, anticipated Iraq's invasion of Kuwait. As late as July 1990, the intelligence community assessed the deployment of eight Iraqi Republican Guard divisions to the Kuwait border as an attempt to pressure Kuwait in the negotiations, not as a prelude to war. Even when the negotiations founders on 1 August, Kuwait refrained from placing its military forces on full alert. Iraqi forces entered Kuwait City hours after the invasion began on 2 August and reached the Kuwait-Saudi Arabian border the next day. Surprised and overwhelmed, the Kuwaitis offered only sporadic resistance, and the Kuwaiti air force fled to Saudi Arabia after destroying a number of Iraqi helicopters and vehicles with their A-4 and Mirage F-1 aircraft.

Most American military and political leaders had also failed to anticipate the Iraqi invasion, which occurred on the very day that President Bush gave an important policy address on the future of American national

security policy. Yet, although preoccupied with Europe and the end of the Cold War, military planners had taken preliminary steps to reorient their focus from a global war with the Soviets to regional contingencies. Beginning in the fall of 1989, U.S. military planning for Arabian Peninsula security shifted from a potential Soviet threat to a regional threat with Iraq as the focus. By the spring of 1990, Central Command (CENTCOM) had prepared a draft operations plan (OPLAN 1002-90, Defense of the Arabian Peninsula) to address such a contingency. The plan, however, only slightly resembled the operations that would unfold. Defensive in nature, it called for early-deploying U.S. forces to trade space for time, while reducing the attacking Iraqi forces until sufficient U.S. forces could deploy for a counteroffensive to recapture lost territory.

Two days after the Iraqi invasion, President Bush convened a meeting of the National Security Council to discuss U.S. options. After briefing possible military options to the President, including those in Central Command's draft contingency plan, the Commander of U.S. Central Command, Gen. H. Norman Schwarzkopf, and his staff prepared for a deployment of forces to Southwest Asia.¹ Their deployment plan would take four months to execute (plus an additional two months for the forces added later) and would depend on the use of some twenty-five regional bases, including some not mentioned in existing plans. Ultimately it would also involve command arrangements with forces from thirty-eight countries. Weeks would be needed to deploy enough troops to defend Saudi Arabia against the Iraqi forces across the border in Kuwait. Schwarzkopf and his planners understood the precariousness of the situation and placed priority on deploying combat units first, at the expense of support and sustainment personnel and equipment.

General Schwarzkopf depended on air power as the essential shield for the build-up of forces necessary to defend the Arabian peninsula. The only forces he had immediately available in the region were a carrier battle group (USS *Independence*), two KC-135 tankers and a mobile operations center deployed (Operation Ivory Justice) to Abu Dhabi at

¹U.S. Department of Defense, *Conduct of the Persian Gulf War, Final Report to Congress*, Apr 1992, pp 32, 334, 350. See Chapter 2 of this report for a discussion of planning for the air campaign.

Figure 1
Map of Region



the request of the United Arab Emirates, and the six Navy ships of Central Command's Joint Task Force Middle East. On 6 August, Saudi King Faud requested military assistance following a meeting in Riyadh with a U.S. delegation that included the Secretary of Defense Richard B. Cheney, Gen. Schwarzkopf, and Lt. Gen. Charles A. Horner, Commander, Air Force Component, Central Command (CENTAF). Schwarzkopf designated Horner the CENTCOM forward commander, placing him in charge of the beddown of forces that began flowing into the theater within days, while Schwarzkopf returned to the United States.

Under an umbrella of Saudi F-15Cs and AWACS on 24-hour defensive air patrol, the build-up of Coalition forces on the Arabian peninsula began. The first aircraft in the region included the USS *Independence* carrier air wing, the First Tactical Fighter Wing (F-15Cs) and E-3 Airborne Warning and Control Aircraft from the United States, and RC-135 (Rivet Joint) reconnaissance aircraft from Europe. Troops from the 82d Airborne Division assumed defensive positions around the airports. By

the end of August, the Royal Air Force had two fighter squadrons in place with accompanying tanker and maritime patrol aircraft, and U.S. forces had increased to 14 tactical fighter squadrons (U.S. Air Force and Marine Corps), 3 carrier battle groups, a B-52 squadron, 4 tactical airlift squadrons, 7 Army and Marine Corps brigades with attack helicopters, and a Patriot air defense system. By the end of the war, more than 3,800 U.S. fixed- and rotary-wing aircraft, 500,000 personnel, and almost 3 million tons of cargo had arrived in the theater.

Moving such a large force over 8,000 miles to Southwest Asia put a tremendous strain on the military transportation system. Over the months of Desert Shield, sealift brought about 95 percent of the equipment and supplies to the region, and strategic airlift (C-5, C-141, KC-10, and Civil Reserve Air Fleet) brought 99 percent of the personnel. In the early days of deployment, all supplies and equipment except for that prepositioned on ships in the region came by air.² Moving personnel and equipment from the few points of debarkation in the theater to the many airfields and staging areas required almost 17,000 C-130 tactical airlift sorties. On 18 August, the President authorized the first-ever activation of the first stage of the Civil Reserve Air Fleet, and on 22 August, he signed Executive Order 12727 authorizing the call-up of 200,000 reservists for a period of up to 180 days.³ Without these measures, the U.S. airlift, taxed to the limit, could not have sustained the required buildup in the theater.

When General Schwarzkopf returned to the theater in late August, an Iraqi invasion of Saudi Arabia seemed less imminent. In retrospect, it appears unlikely that Iraq had ever intended to invade Saudi Arabia immediately after seizing Kuwait. Once in Kuwait, Iraqi forces quickly assumed a defensive posture, and Saddam Hussein's determination to retain Kuwait was beyond all doubt. Baghdad remained unmoved by the United Nations resolutions of 2 and 6 August, which condemned the invasion, called for the restoration of Kuwait, and authorized a multinational embargo of all trade to Iraq. Saddam Hussein declared Kuwait the nineteenth province of Iraq,⁴ took Americans and other foreigners in

²Chapter 8 discusses equipment and supplies brought to the theater.

³Chapters 7 and 8 contain further discussion on the airlift forces employed.

⁴Radio Baghdad broadcast, 8 Aug 1990.

Kuwait and Iraq hostage, and in October, declared that if war came, Iraq would launch missile attacks against Saudi Arabia and Israel. Since Iraq was known to possess chemical munitions and was believed to have biological weapons, these threats raised the prospect of grave danger to the Gulf states, Israel, and deployed Coalition forces.

As Coalition forces grew, a dual chain of command evolved, with Saudi Lt. Gen. Khalid as the Commander, Joint Forces and Theater of Operations, and General Schwarzkopf as the commander of all U.S. forces in the theater. General Horner assumed operational duties as the area Air Defense Coordinator, the Airspace Control Authority, and the Joint Force Air Component Commander (JFACC) responsible for planning, coordinating, allocating, and tasking theater air operations derived from General Schwarzkopf's apportionment decisions.⁵ Horner exercised his authority through the daily air tasking order (ATO), which provided detailed direction, with some exceptions, for all Coalition flight operations during both Desert Shield and Desert Storm.

The daily air tasking order became a subject of contention. It comprised some 200 pages in standard message format or approximately 800 pages on the Computer-Assisted Force Management System. It contained times, targets, altitudes, call signs, radio frequencies, and other necessary mission information. CENTAF found its daily construction and dissemination to all units concerned a massive task. The Services and Coalition forces accepted the need for a single authority to coordinate an air campaign and to provide safe separation of the 2,000 to 3,000 aircraft sorties flown per day in the theater's limited airspace. However, they had, to varying degrees, reservations about General Horner's authority to select the targets and prescribe the flight operations for the many elements of the Coalition air forces. Eventually, the ATO directed almost all Coalition fixed-wing aircraft sorties, although it did not always impose tight control over these aircraft.⁶ Helicopters flying less than 500 feet above

⁵(S) Msg. USCINCCENT, 101100Z Aug 1990, para 3E26, GWAPS, CHC 12-15. See A Note on Sources at the end of this report for an explanation of GWAPS citations used in footnotes.

⁶Discussion of the JFACC organization and procedures is contained in Chapter 5. Sorties from Turkey (Proven Force) did not appear in the ATO.

the ground were exempted from direct JFACC control, as were naval aircraft on overwater flights.

From the first, General Horner had to concern himself with getting forces to their bases and planning for the defense of the Arabian peninsula. Early on, he appointed U.S. Air Force Brig. Gen. Buster Glosson as director of a special planning group to plan for offensive air operations against Iraq. This effort drew, in turn, on Instant Thunder, a plan developed in early August by the Air Staff. General Glosson's special planning group, known as the Black Hole, consisted primarily of Air Force officers but eventually included officers from all the Services as well as British and Saudi representatives. The Black Hole, working in great secrecy, had a plan ready for implementation in mid-September, ahead of the arrival of the main ground forces. The plan sought to dislodge the Iraqi forces from Kuwait by attacking key Iraqi targets such as leadership and command and control systems; key nuclear, biological, chemical, electrical, military, and oil production facilities; bridges, railroads, and port infrastructure; and air defense, naval, missile, and ground forces, particularly the Republican Guard. The offensive air campaign supported the CENTCOM plan, which called for four phases: Phase I, a strategic air campaign against Iraq; Phase II, suppressing enemy air defenses in the Kuwait Theater of Operations; Phase III, preparing the battlefield; and Phase IV, a ground campaign. This air campaign plan from the Black Hole was accepted by the President in October, as was the plan for employing the Coalition ground forces. Lack of ground forces limited the ground attack options to a frontal assault into Kuwait.

Because a Coalition frontal assault raised the likelihood of heavy Coalition losses, the President authorized the addition of more ground and air forces to enhance Schwarzkopf's options. As a result, a second phase of deployment, begun in late November 1990, increased the forces already in the theater by 400 Air Force aircraft, 3 carrier battle groups, and more than 4 Army and Marine divisions, including the European-based U.S. VII Corps. The new deployments also entailed activation of more reserves. Arab and European Coalition members proportionally increased

their forces. Arrival of the additional forces coincided with the deadline set for Iraq to evacuate Kuwait—15 January 1991.⁷

By mid-January, the Coalition force included nearly 1,800 combat aircraft from 12 countries, a large naval force in the Persian Gulf and Red Sea, and approximately 540,000 ground troops from 31 countries. The total Coalition force numbered in excess of 660,000.⁸ The increased number of Coalition air and ground forces allowed Schwarzkopf to concentrate on his main goal, enveloping the Republican Guard and Iraqi regular army divisions. To do this, he would launch Phases I, II, and III of the aircraft campaign, while he repositioned the bulk of his forces to the west in preparation for Phase IV. During the preceding months, the Coalition air forces had honed their skills and learned to operate together through exercises that not only rehearsed planned missions but also desensitized the Iraqi air defenses to Coalition flight patterns. Once the air campaign began, effectively shutting off Iraqi surveillance of the Coalition ground forces, the U.S. XVIII Airborne Corps and VII Corps would deploy to the west (Figure 2) to set the stage for enveloping the Iraqi ground forces. As the Marines (MARCENT) and two Arab corps (JFC-N and JFC-E) attacked to hold Iraqi forces in place, and as the 4th Marine Expeditionary Brigade faked an amphibious assault, the two westward corps would attack the Iraqi force on the flank (Figure 3).⁹

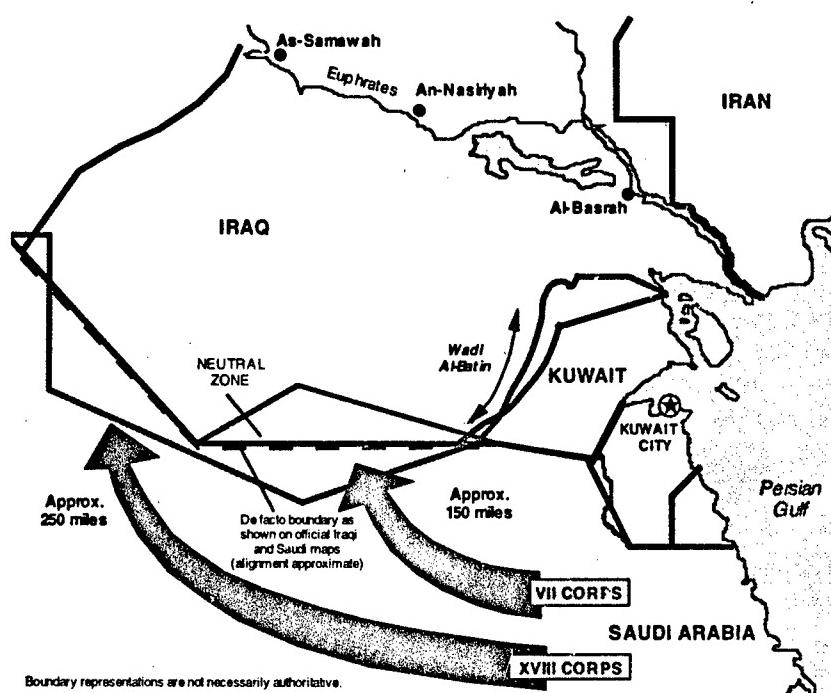
Iraqi ground forces facing the Coalition also grew over the months of the Coalition's build-up. Beginning with the 14 divisions estimated to be in the theater in September, the Iraqi army increased gradually until November, when Baghdad announced it would send another 250,000

⁷On 29 Nov, the UN Security Council voted to authorize force to expel Iraqi forces from Kuwait if they had not evacuated by 15 Jan 1991.

⁸*Conduct of the Persian Gulf War*, pp 85-86. As of 15 Jan 1991, Central Command strength was 454,128: ARCENT-247,637; CENTAF-48,679; NAVCENT-67,851; MARCENT-85,447; SOCCENT-3,279; CENTCOM HQ and JCSE-1,235. By 27 Feb 1991, CENTCOM strength had grown to 541,376 (GWAPS, *Statistical Compendium*, Table 14, Theater CENTCOM Personnel Strength at Weekly Intervals, p 60).

⁹This brief summary does not identify all the ground forces engaged in this attack. For instance, a French division was attached to the XVIII Corps and a British division to the VII Corps. Maps are extracted from *Conduct of the Persian Gulf War*, pp 244, 247.

Figure 2
Shift to the West by U.S. XVIII Corps and VII Corps

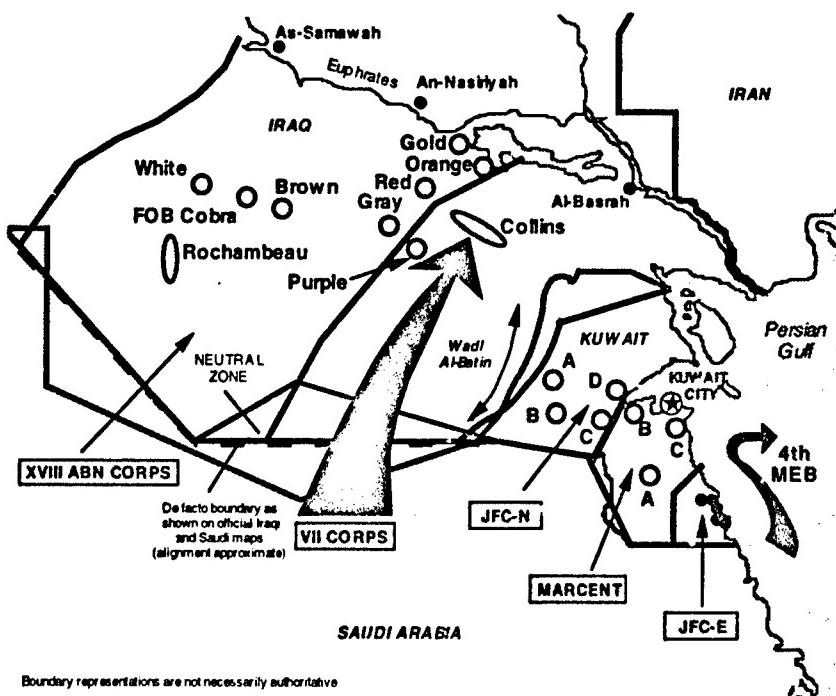


troops to the theater in response to the announced Coalition increase, bringing the number of Iraqi troops to a nominal 680,000.¹⁰ In January 1991, the Defense Intelligence Agency estimated that Iraq had 42 to 43 divisions in the theater with 540,000 troops, more than 4,200 tanks, 2,800 armored personnel carriers, and approximately 3,100 artillery pieces. In addition to its ground forces, Baghdad had more than 700 combat aircraft and a multilayered air defense system, a navy of missile-firing patrol boats, and Silkworm surface-to-surface missiles for coastal defense.¹¹

¹⁰*New York Times*, 20 Nov 1990, p A-1.

¹¹*Conduct of the Persian Gulf War*, pp 11-13, 84-85.

Figure 3
Coalition Plan for Ground Attack



Postwar analysis confirmed this number of Iraqi divisions but concluded that the number of troops, armor, and artillery in these units was overstated. Most divisions deployed understrength, particularly those on the front lines in the western part of the theater (total undermanning of 120,000)¹² Also, Iraqi policy allowed frequent leaves, meaning that a large number of soldiers, absent when the air campaign began, never rejoined their units. The Survey authors judge that 20 percent, or 84,000

¹²Such a disposition of divisions would make sense in light of the Iraqi anticipation of a Coalition attack coming up the coast road or from the area of the Wadi al Batin (into either the Iraqi IV or III Corps areas). Note, however, that some units deployed at close to full strength. As a result, any theater-wide assessments based on manning of frontline units should be made with caution.

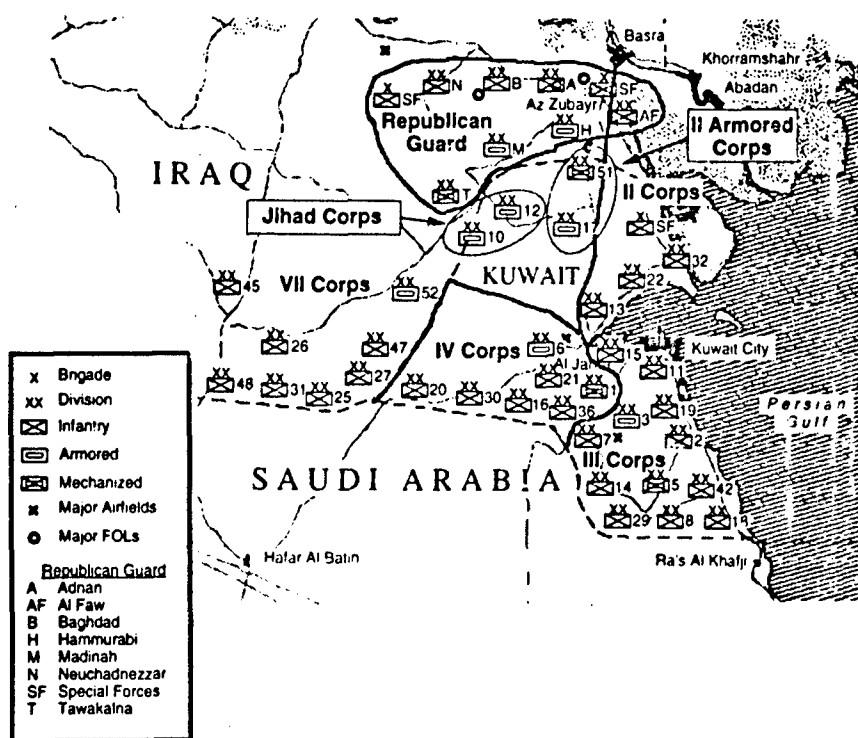
troops, were either on leave or had deserted when the air war began.¹³ Applying these decrements to the original Defense Intelligence Agency estimate results in a revised estimate of no more than 336,000 Iraqi troops in the theater on 17 January 1991.

While exact numbers were unknown, U.S. planners had a fairly accurate overall picture of Iraqi deployments in the theater by the beginning of the war (Figure 4). Coalition reconnaissance clearly established the purpose and general location of Iraqi ground forces, which had deployed in three defensive lines or echelons. The frontline forces—closest to the Kuwait-Saudi border—were intended to slow and attrit the initial Coalition attack and allow the Iraqi military leadership to determine its main axis. The frontline forces consisted of infantry divisions from three corps arrayed east to west with Iraqi III Corps facing MACV-CENT and JFC-E, IV Corps facing JFC-N, and VII Corps west of Wadi al Batin. The second Iraqi echelon comprised the tactical and operational reserves of armored and mechanized divisions deployed throughout central Kuwait and southern Iraq. Their mission was to reinforce other units and block Coalition penetration of the front lines. (The tactical reserves were the 1st, 3d, 5th, 6th, and 52d Divisions. The operational reserves were the 17th and 51st Divisions, the II Armored Corps, and the 10th and 12th Divisions, the Jihad Corps.) The Republican Guard formed the third echelon north and west of the Kuwait border. These divisions, including the heavy divisions of the Guard—the Tawakalna, Madinah, and Hammurabi—were the strategic reserve poised to counterattack against the main Coalition attack.¹⁴ Other infantry divisions of Iraq's II Corps deployed north of Kuwait City along the shoreline with general missions of reinforcing the main body, protecting the coast, and defending against possible airborne attacks into central Kuwait. Central Command

¹³Desertions before 17 Jan are counted within the twenty percent authorized to be on leave. This decrement could be greater if there was a substantial early desertion rate in addition to the numbers on leave. Having such a large portion of the army on leave with an attack pending appears unusual, but numerous prisoner-of-war reports confirm the practice. The program of frequent leave appears to have been used to keep troop morale up and desertions down. A like system was in place during the Iran-Iraq War.

¹⁴*Conduct of the Persian Gulf War*, pp 110-12. Note: heavy division is the term describing either an armored or mechanized division.

Figure 4
Iraqi Deployment in KTO on 17 Jan 91



assessed the three lines of defensive formations as twenty-five committed, nine reinforcing, and eight theater reserve divisions.¹⁵

Early on 17 January, the Coalition launched a concentrated air campaign against strategic military, leadership, and infrastructure targets in Iraq. Even before the first shots were fired at 0238 local time by helicopters

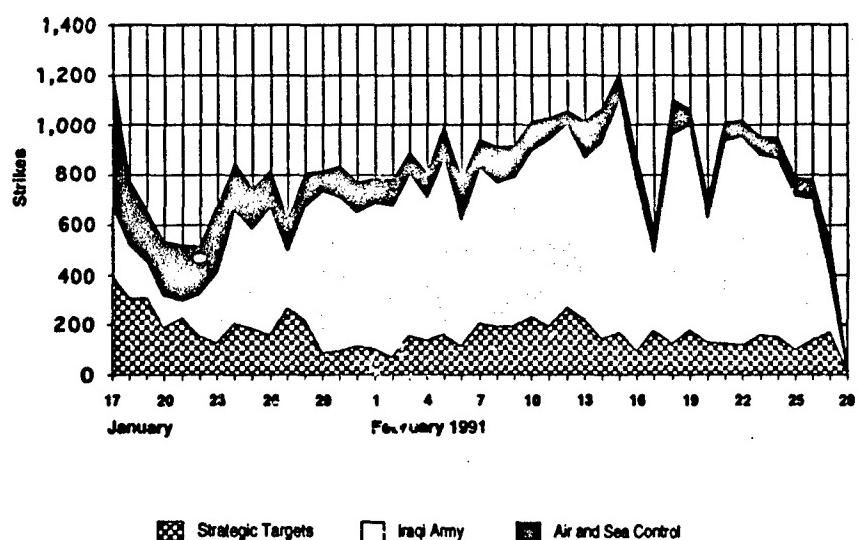
¹⁵(S) USCENTCOM Situation Report, 23 Feb 1991, GWAPS, CHST 68.

attacking an early-warning radar site in southern Iraq, B-52s from Barksdale Air Force Base in Louisiana were en route with conventional cruise missiles, Navy ships had fired salvos of Tomahawk land-attack missiles (TLAMs), and F-117 stealth aircraft were approaching Baghdad. Waves of aircraft followed, rapidly sweeping into Iraq, attacking airfields, nodes of the integrated air defense system, and leadership command and control systems, known Scud sites, nuclear/chemical/biological production sites, and electrical power facilities. By dawn, the attacks spread to include ground forces in the Kuwait Theater of Operation. (The Kuwait Theater of Operations was defined as the area north of the Saudi Arabian border, south of the 31 degrees north latitude line, west of the Gulf and the Iran-Iraq border, and east of the 45 degrees east longitude line.) The second night and day were characterized by more of the same attacks, with oil production and storage facilities and naval sites coming under assault. The first 2 days of air operations were the most thoroughly planned and the most complex of the war, as Coalition commanders attempted to dismember Iraqi air defenses and at the same time attack targets across the entire spectrum of strategic target sets. To accomplish this, planners employed their entire arsenal of air weapons, including stealth F-117s, Tornados with JP-233 runway attack munitions, F-15Es, attack helicopters, drones, and conventional air-launched cruise missiles. The Coalition hit virtually every target set on the initial strikes, although the greatest weight of effort was directed against air defenses, airfields, and command elements of the Iraqi regime. Although sortie rates remained at similar levels throughout the war (with 2,759 flown the first day, including 432 refueling sorties), subsequent strikes were never as complex or focused, nor perhaps did they need to be (see Figures 5 and 6).

The prime concern of commanders during the first days was to gain and maintain air superiority. To do this, they employed an array of specialized aircraft that included dedicated air-to-air fighters (F-15Cs and F-14s); airborne warning, control, and intelligence aircraft (E-3s and RC-135s); electronic jamming support aircraft (EF-111s and EA-6s); and aircraft firing high-speed antiradiation missiles (HARMs) at Iraqi search and tracking radars. Additionally, two types of radar-decoy drones stimulated Iraqi radar activity, thereby deflecting attention from strike aircraft and encouraging surface-to-air missile radars to remain active and therefore vulnerable to HARM missiles. The F-4Gs alone expended 118 HARMs the first night. Almost half of the 1,961 HARMs expended by

the Services were launched during the first week of the war. After that, just the threat posed by the HARMs kept most Iraqi radars off the air. The decoys, too, were used principally during the first week of the war, most on the first night and only sparingly after that. Not surprisingly, most Iraqi air combat sorties and air-to-air losses (14) to Coalition fighters occurred during that same first week of the war. Subsequent losses occurred when Iraqi aircraft attempted to flee to Iran, not while trying to defend Iraqi airspace. By 27 January, air supremacy was achieved.

Figure 5
Coalition Air Strikes by Day Against Iraqi Targets

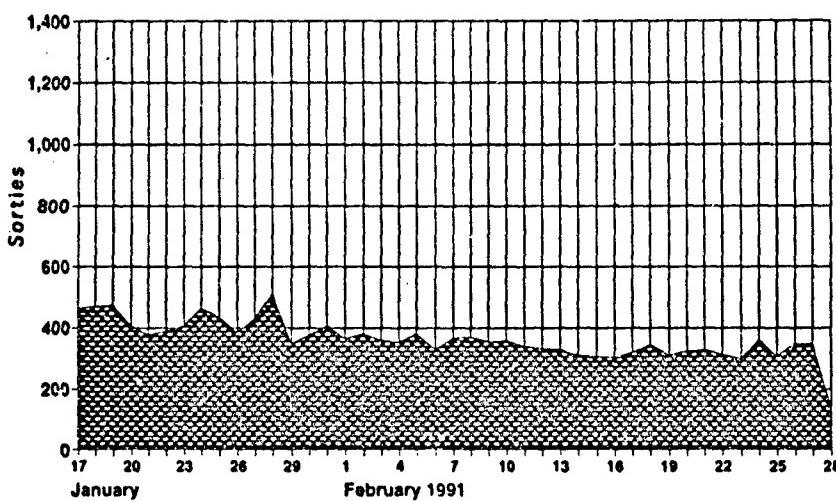


Strategic targets are defined in Chapters 2 and 3 (see in particular Figure 12). Iraqi army strikes include attacks on equipment, troop concentrations, and logistics sites of the Iraqi army in the Kuwait theater. Air and sea control includes attacks on airfields, air defense sites, and Iraqi naval and coastal defense targets.

Source: GWAPS Database.

The nature of the strategic targets in Iraq required careful weaponeering (choice of weapons to match particular targets) to achieve the desired effects and accuracy, to avoid excessive collateral damage, and to reduce the risk of delivery aircraft having to conduct repeat attacks. Some target systems succumbed quickly—electrical power, for example. Other target sets consisting of a greater number of individual targets (for example, almost 600 hardened aircraft shelters) required repeated strikes throughout the war. Most targets in these target categories required precision-guided weapons with a capability to penetrate hardened buildings. The softer, area targets such as oil storage facilities could be struck with nonprecision gravity bombs. Virtually all American laser-designating aircraft participated in the strategic air campaign in Iraq. Since the risk of flying aircraft over Baghdad during daylight was high, TLAMs were used to

Figure 6
Coalition Air-to-Air Sorties by Day
(Defensive Counterair and Combat Air Patrol)



Source: GWAPS Database.

keep the pressure on during daylight. Precision weapons were at a premium, so much so that aircraft capable of using them could not be spared to attack bridges until the second week in the war. Only then did bridges receive attention. While most of the laser-guided bombs and surface-to-surface and air-to-surface missiles expended in the course of the 43-day air campaign were expended against facilities, a large number were used against air installations and Iraqi ground forces, mainly in the course of direct attacks against armor.

Although strikes in Iraq required the use of precision weapons, the air attacks that began almost simultaneously in the Kuwait theater employed mainly unguided bombs and a variety of antiaarmor and antipersonnel cluster munitions. Many targets in the theater were well suited for these weapons—storage areas and troop concentrations called for area weapons. However, the type of aircraft available frequently dictated the choice of armaments. While the relatively small number of aircraft equipped to laser-designate targets operated over Iraq, the larger number of aircraft not so equipped operated profitably throughout the Kuwait theater, dropping less precise munitions in large numbers. General Schwarzkopf desired that air power reduce enemy ground force combat potential in the Kuwait theater by fifty percent before he would start the ground assault.

Even within the Kuwait theater, there was a division of labor between the aircraft employed in the northern portion against the Republican Guard and those employed in the southern portion near the front line. F-16s, F/A-18s, F-15Es, F-111s, and A-6s flew against the more distant, better equipped, and better dug-in Republican Guard. Closer to the front, AV-8Bs, A-10s, and many of the other Coalition aircraft (F-5, Jaguars, A-4s) tackled the entrenched Iraqi infantry. B-52s, dropping approximately thirty-two percent of the bomb tonnage in the war (most of it in the Kuwait theater), attacked area targets (breaching sites, ammunition stockpiles, troop concentrations, and military field headquarters) and became one of the most sought-after aircraft by the ground commanders for strikes against Iraqi ground forces. Attempts by air planners to employ B-52s outside the Kuwait theater (on munitions storage sites in Iraq, for example) ran into much opposition from the CENTCOM leadership,

particularly General Schwarzkopf.¹⁶ Army and Marine commanders, meanwhile, had restricted the employment of attack helicopters until the approach of the ground war.

The decision to bomb from medium altitude affected the accuracy of nonprecision weapons. Before the war, planners anticipated using this tactic only during daylight. However, after three days of actual combat and the loss of several aircraft, commanders restricted all bombing missions to medium altitude. Attacking from altitudes of approximately 10,000 to 15,000 feet (above the reach of antiaircraft artillery and infrared surface-to-air missiles) increased survivability, but at the expense of bombing accuracy. Given the conditions of the war and the need to minimize casualties, the move made sense. However, a consequence of the altitude restriction was the need for higher weather ceilings in order to deliver ordnance visually; thus a higher-than-anticipated incidence of mission changes occurred because of weather. Air Force planners estimated that by 6 February, three weeks into the war, approximately half of the attack sorties into Iraq had been diverted to other targets or canceled because of weather-related problems.¹⁷ The weather not only impeded accuracy but also hampered accurate bomb damage assessment.

On 18 January, U.S. Air Force aircraft began flying strike missions from Incirlik in Turkey against targets in northern Iraq as a way of pinning down Iraqi forces in that region. These aircraft were part of Joint Task Force Prover Force, formed from units in Europe into a composite wing (fighter, tanker, reconnaissance, and electronic-warfare aircraft). The task force flew fifty to sixty strikes ^ day in three waves (two in daylight, one at night) throughout the war. The strikes from Turkey concentrated on air defenses and airfields; chemical, biological, and nuclear facilities; electric power plants and oil refineries; and munitions storage locations in the north. Late in the war, when the focus of the other Coalition sorties was on the Kuwait theater, Proven Force aircraft

¹⁶(S) Intvw, GWAPS staff with Lt Col David A. Deptula, 21 Dec 1991. Lt Col Deptula was an original member of the Black Hole planning group and became Gen Glosson's principal deputy for planning attacks against strategic targets in Iraq.

¹⁷(S) Brfg viewgraph, prepared by AF/XOXWF for the Secretary of Defense visit to Checkmate, 6 Feb 1991, GWAPS, CHC 1-6.

ventured as far south as Baghdad. Compared to the other Coalition air forces, however, Proven Force had two related handicaps: it had no stealth aircraft (F-117s) and no aircraft capable of designating targets for laser-guided bombs. As a result, the hardened Iraqi air defense network presented Proven Force with a formidable obstacle, one that had to be overcome before attacks on strategic targets could begin. Similarly, Proven Force's attacks against point targets were less successful, required more aircraft, and necessitated more frequent return visits than the better-equipped aircraft based in the south.¹⁸

Almost from the beginning, circumstances dictated diversions from the planned strategic air campaign. The first change occurred on the second day when the first Scud missiles launched from western Iraq landed in Israel. Iraq's attempts to split the Coalition by firing Scud missiles at Israel were anticipated before the war, and for that reason the fixed Scud sites in western Iraq were targeted on the first night's raid. These strikes failed to neutralize what became the true Scud threat—mobile Scud launchers capable of moving from hidden sites, firing, then hiding again before aircraft could attack them. Intensive combat operations began in an attempt to find, destroy, or simply suppress the mobile missiles; these activities continued throughout the war. The Scud hunt included continuous airborne surveillance of western and southern regions of Iraq, positioning strike aircraft within the Scud launch areas for more immediate targeting, attacks on communication links thought to be transmitting Scud launch authorization, attacks of suspected sites, and strikes against Scud production and storage facilities. By war's end, nearly every type of strike and reconnaissance aircraft employed in the war participated in the attempt to bring this threat under control, but with scant evidence of success.

A second redirection of targeting involved digging the Iraqi air force out of its shelters. Subject to almost immediate engagement by Coalition aircraft ranging over their bases, the Iraqis elected not to contest control of Iraqi airspace and sought protection in hardened aircraft shelters that they thought immune from Coalition attack. On 23 January, airfield attack operations shifted from attacking runways to destroying aircraft

¹⁸(S) CMSgt Jerome E. Schroeder and SMSgt Thomas L. Raab, *History of Joint Task Force Proven Force*, Hq USAFE History Office, 1991, pp 45-70.

shelters to remove the threat of these aircraft. Attacking the nearly 600 Iraqi shelters required a substantial shift of resources, mainly F-117s and F-111Fs dropping laser-guided bombs. For two weeks, F-111Fs devoted approximately 60 percent of their strikes to these shelters. They were then drawn off for use against tanks and other ground force equipment. Twenty-eight percent of the total British precision-bombing effort was against hardened shelters. Meanwhile, F-117s continued to prosecute shelter attacks until the last week of the war.

The shelter campaign took away the Iraqi air force's last chance of surviving the war reasonably intact. Unable to maintain the force as a strategic reserve (as it had during the Iran-Iraq War), Baghdad attempted to evacuate its combat aircraft to Iran. In the four-day period beginning on 26 January, nearly 80 aircraft fled across the border. By the end of the first week of February, a total of more than 100 aircraft fled and were interned by the Iranian government. The Coalition established air patrols between the Iraqi air bases and the border in an attempt to stem these escapes and shot down several Iraqi aircraft. Other Iraqi aircraft, in their efforts to escape in low-level dashes, ran out of fuel and crashed. The Iraqis also dispersed their remaining aircraft around airfields, on roads, in residential neighborhoods, and even near archaeological sites, taking advantage of the Coalition's known desire to avoid collateral damage. Through these measures, some Iraqi aircraft survived the war, but the Iraqi Air Force ceased to operate as an effective combat force. In fact, Baghdad's only known attempt at an offensive air strike took place on 24 January when two Iraqi F-1s attempted a low-level dash over the Persian Gulf, most likely to attack Coalition ships. A Saudi F-15C pilot downed both aircraft before they could reach their target.

The weight of effort by nonlaser-designating aircraft shifted to the Kuwait theater beginning in the second week. Air attacks attempted to fix the Iraqi ground forces in place, seal off the area from resupply by attacking traffic within the area, and destroy equipment. Together with the bombing effort, psychological operations increased as Coalition leaflets in the millions, radio broadcasts, and loudspeakers encouraged Iraqi soldiers to lay down their arms.

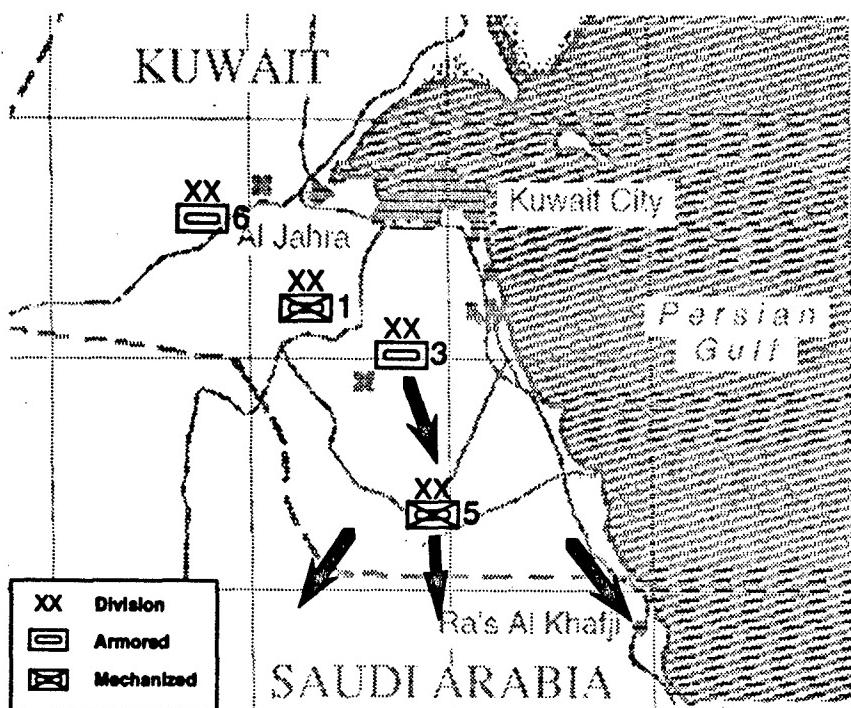
After a week of air attacks against Iraq and its forces in the Kuwait theater, Baghdad began taking desperate measures to precipitate a ground

war. While Iraq had anticipated an initial period of air attacks, the actual attacks were longer and more severe than expected, and a Coalition ground attack still appeared no closer to getting underway. Before the war, Saddam Hussein had boasted of the Iraqi advantage in a ground war; he predicted that mounting casualties would split the Coalition and turn the U.S. public against the war. On 22 January, Iraq set fire to two oil refineries and an oil field near the Kuwait-Saudi border. A day later, Iraq opened oil manifolds in several offshore terminals, allowing crude oil to pour into the Persian Gulf. Whether Iraq's intent was to provoke a ground war or to make an amphibious assault more difficult is not known, but attacks by two F-111Fs using GBU-15 precision bombs on the oil manifolds at the Al Ahmadi refinery on 27 January stopped the oil flow into the Gulf.

On 29 January, the Iraqi army attempted to prompt a ground war by launching attacks into Saudi Arabia from several points in southeastern Kuwait; the most prominent attack was against the Saudi Arabian town of Al Khafji (see Figure 7). Saddam Hussein ordered the attack to induce the Coalition into a ground war, heighten the morale of his own forces by taking the offensive, and take prisoners as a source of intelligence in order to determine the Coalition's intentions.¹⁹ The result was a defeat for the Iraqis in several ways. They occupied the abandoned and unguarded town of Al Khafji for a day, but Coalition forces quickly evicted them. Attempts to assemble Iraqi reinforcing columns in Kuwait were detected by a variety of night reconnaissance systems, including the newly arrived JSTARS (Joint Surveillance Target Attack Radar System) E-8 aircraft, and the columns were routed by air attacks. Having failed to precipitate a greater ground war, the Iraqis simply took to their defensive emplacements to await their fate.

¹⁹Although Saddam Hussein's intentions may never be known, this synopsis follows the widely accepted interpretations of Iraqi action by CENTCOM and Washington intelligence organizations during and after the war. Enemy prisoner of war reports provide positive confirmation of this interpretation of events, and no reports dispute it [(S) Msg Defense Intelligence Agency, dtg 151959Z Feb 91, subj: NADA INTSUM 207-91, GWAPS, CHST 45-33].

Figure 7
Attacks of the Iraqi III Corps, 29-31 January 1991



While the action at Al Khafji provided the first instances of combined ground action involving the Coalition Arab forces and U.S. forces and the first true instances of close air support in the war, it also proved costly. The engagement produced several incidents of fratricide: thirteen Marines and four Saudi soldiers were killed in three incidents, two occurring during air-to-ground attacks.²⁰ It also resulted in the single greatest loss of Air Force personnel when an AC-130 gunship was shot down with its fourteen-man crew.

²⁰Office of Assistant Secretary of Defense (Public Affairs), *News Release No. 504-91*, 13 Aug 1991.

Before and during the Al Khafji attacks, Coalition aircraft destroyed nearly all Iraqi missile boats. Many of them were destroyed as they apparently attempted to flee to Iran, much as Iraqi aircraft had done several days before. The Iraqi Navy was small, but even the presence of small missile-firing boats posed a threat to the Coalition battle groups and amphibious forces. The destruction of the missile boats allowed freer action for the Coalition forces in the northern Gulf, although the presence of Silkworm missile sites along the coast remained a threat throughout the remainder of the war.²¹

In early February, as CENTCOM's focus shifted to the Kuwait theater in preparation for the ground offensive, aircraft claims in reducing the effectiveness of the Iraqi Army (planning was based on attriting 50 percent of Iraqi armor, artillery, and armed personnel carriers) began to be questioned. Washington and the theater leaders disagreed over what level of success was being achieved, but a greater effort was clearly called for. To increase the lethality of the attacks, A-10s, thought to be the most effective aircraft against armor, decreased their attack altitude to between 4,000 and 7,000 feet.²² A second adjustment, one that led to far better results, was employing laser-guided bombs against Iraqi armor. F-111Fs conducted night tests during the first week of February using their infrared sensors to detect the hot skin of the tanks (or any other metal equipment) contrasted against the cooler sand that surrounded them. Following these tests, F-111F, F-15E, and A-6 aircraft flew laser-guided bomb attacks against Iraqi armor in a procedure known as "tank plinking." From that point, the number of recorded armor and artillery kills climbed rapidly.²³ During the later stages of the air attacks to prepare the

²¹The missile boats and Silkworm missiles were not the only threat to the naval forces. Aircraft with air-to-surface missiles could launch from Iraqi (and possibly Iranian) bases and pose a longer range threat to the fleet. Information drawn from two Center for Naval Analyses reports: (S) Peter P. Perla, *Desert Storm Reconstruction Report, Volume I: Summary*, and Jeffrey Lutz, et al, *Desert Storm Reconstruction Report, Volume VI: Antisurface Warfare* (Alexandria, VA: 1991).

²²During this same period, the employment of F-16 killer scouts (Pointers) began, and F-16s were directed to release bombs below 8,000 feet (see Lt Col Lewis point paper, "Corps Air Support at Desert Storm," 3 Jul 1991, GWAPS, CHST 22-15); (S) 23/354 TFW(P) "Battle Staff Directive No. 26," 31 Jan 1991, GWAPS, Microfilm Roll 26554.

²³See discussion in Chapter 3.

battlefield for the ground attack, the weight of effort shifted from the Republican Guard and other heavy divisions in the Iraqi theater reserve to more direct attacks on the Iraqi frontline divisions. More B-52 sorties flew against the frontline forces to effect breaching operations. MC-130s dropped BLU-82 (15,000-pound) bombs to clear mine fields and support psychological operations. Following the loss of two A-10s 60 nautical miles north of Kuwait City in mid-February, which prompted General Horner to restrict A-10s to targets along the Saudi-Kuwait border in Kuwait, a greater concentration of A-10s attacked the Iraqi regular army forces in the front lines. Specific objectives included preparing breaching sites in Iraqi defenses, destroying artillery in the breach areas, and bombing the pumps used to fill Iraqi fire-trenches. As air power began to focus on the upcoming ground campaign, the continuing strategic air campaign momentarily came to the fore with the attack on the Al Firdos bunker on the night of 12-13 February. The Coalition did not know that the bunker, a legitimate military target, had also served as a civilian shelter when F-117s struck it. The resulting controversy over the deaths of several hundred civilians resulted in tightened control from Washington of attacks into downtown Baghdad.

In preparation for the Coalition ground offensive, air and ground units began rehearsing close air support procedures. As part of these preparations, General Horner established new rules of engagement to support the ground campaign. He eliminated minimum-altitude restrictions and instructed crews to press their aerial attacks in every way possible to protect Coalition ground forces while maintaining an appropriate level of caution for aircrews. General Horner summarized his guidance:

The weather considerations that were valid last week are no longer valid. There are people's lives depending on our ability to help them if help is required. So I want a push put on. I want people feeling compulsion to hit a target. I do not want fratricide. So if in doubt don't shoot.²⁴

²⁴(S) Comments from log of 24 Feb 1991, Hq CENTAF Office of History, *Daily Comments of Lt General Charles A. Horner, 17 January through 28 Feb 1991*, GWAPS, CHP 13B.

While air power employed during the incursion at Al Khafji was an unrehearsed response to an unexpected action, the air power supporting the ground offensive of 24 to 28 February was well planned. The date for the offensive was known, sorties apportioned, and the procedures practiced. Air operations were coordinated and geared to support the ground offensive with large numbers of aircraft sorties planned for close air support and to interdiction across the Kuwait theater.

The bulk of the Coalition aircraft not planned for close air support were tasked to fly interdiction sorties. Commanders intended these sorties to destroy supplies and prevent Iraqi reserve forces from reinforcing the front lines or to catch retreating troops by striking headquarters, roads, and bridge networks. Attacks by Coalition aircraft extended throughout the theater, with Navy (from the Gulf carriers) and Marine sorties concentrating on eastern Kuwait. Many of the night flyers (F-111s, F-15Es, A-6s, and the LANTIRN-equipped F-16s)²⁵ focused on targets in the northern part of the theater to damage the heavy divisions further and disrupt road traffic. B-52s flew around the clock: on the first day, they hit breaching sites and frontline forces; on subsequent days they struck headquarters and staging areas just south of the Euphrates River in Iraq.²⁶ The plan intended to put maximum pressure on the Iraqi forces with every type of strike aircraft at the Coalition's disposal.²⁷

When the ground offensive began at 0400 local time on 24 February, the system needed all the flexibility it could muster to deal with the rapidly changing conditions. More than 3,000 sorties flew that day, mostly in the confined airspace over the battlefield. The generally light opposition to the rapid ground advance generated few targets for close air

²⁵Two squadrons of F-16s had navigation pods of the low-altitude navigation and targeting infrared for night (LANTIRN) system.

²⁶(S) Master Attack Plans, 24 through 27 Feb 1991, GWAPS, BH 1.

²⁷Although the F-117s and Tornados only marginally so: F-117s continued to hit strategic targets in Iraq, and Tornados were employed principally against airfields in Iraq. The Proven Force F-16s and F-111s, which could not reach the Kuwait theater, continued to strike targets in northern Iraq.

support aircraft, and a period of poor weather and restricted visibility caused by oil fires limited the ability of many aircraft to perform close air support.

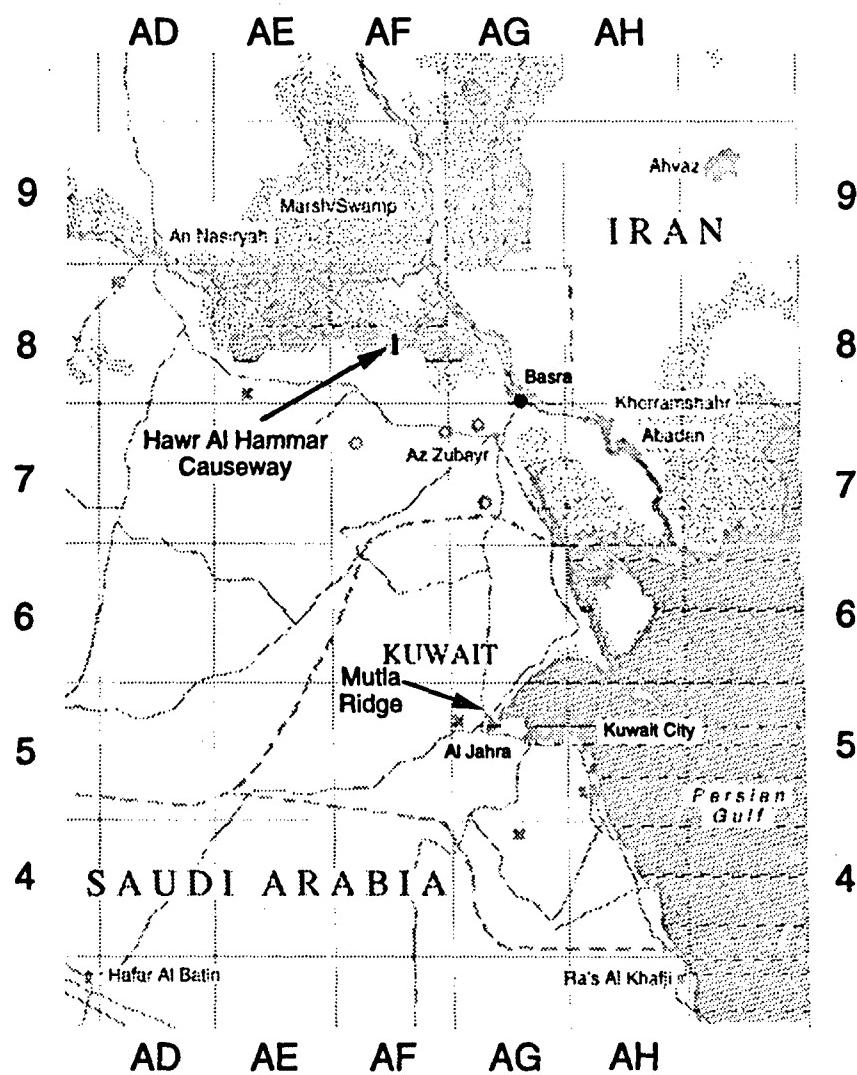
Fortunately, Coalition planners enjoyed a comfortable surplus of available close air support sorties that could engage alternate targets well ahead of the rapidly moving ground advance. Aircraft equipped with radar-aimed release systems used this less accurate tactic, while many of those not so equipped had to return with their bombs. While some sorties of true close air support did fly, most of the effort, and the subsequent destruction, fell on the heavy reserve divisions and the retreating columns of the Iraqi army as it fled Kuwait. The highway proceeding northwest out of Kuwait City and Al Jahra and over Mutla Ridge, the "highway of death," was one such bottleneck of traffic that came under attack during this retreat (see Figure 8).²⁸

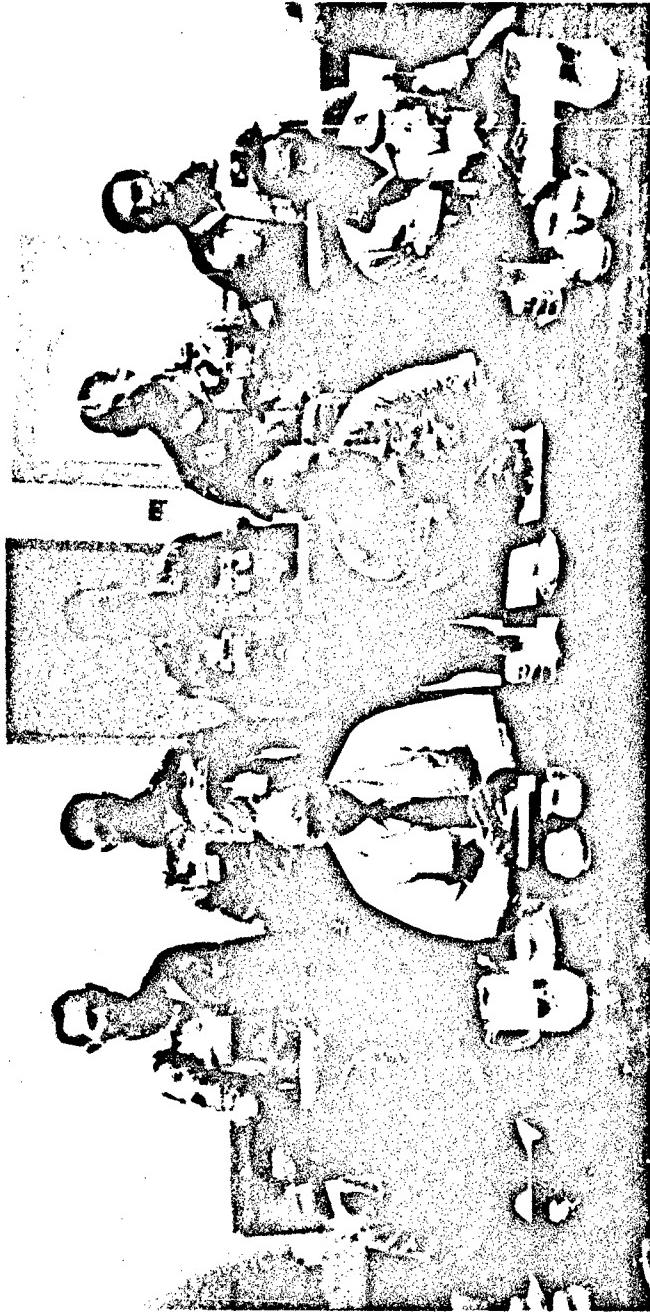
In the later stages of the war, the air effort focused on supporting the ground campaign. Air attacks throughout Iraq continued, however, destroying bridges to the theater, military support facilities, and communications within the theater, and attacking surviving or newly identified Scud, chemical, biological, and nuclear sites. In addition, Baghdad, which generally had been spared since 13 February, came under renewed air attack during the final four days of the war, as U.S. planners made a last attempt to cripple the national leadership. This last effort included an F-111F attack on deep bunkers with GBU-28 deep-penetrator weapons.

The war ended with a Coalition-declared cease-fire at 0800 on 28 February 1991. The Iraqi army had been driven into a corner of southern Iraq, south of the Euphrates River and west of a canal near Basra; neither waterway was easily passable. Coalition ground forces had reached the banks of the Euphrates River and had approached to within thirty miles of Basra. Arab forces occupied Kuwait City. By any measure, Iraq had suffered a crushing military defeat, and air power had proved central to that outcome.

²⁸See discussion in Chapter 3.

Figure 8
Chokepoints for Retreating Iraqi Troops
in the Kuwait Theater





DOD leadership during the Gulf War: (front row, from left) Gen Colin L. Powell, USA, Chairman, Joint Chiefs of Staff; Hon. Richard B. Cheney, Secretary of Defense; Gen H. Norman Schwarzkopf, USA, Commander In Chief, U.S. Central Command (CINCCENT); Lt Gen Calvin A.H. Waller, USA, Deputy CINCCENT; (back row from left) Lt Gen Walter E. Boomer, USMC, COMUSMARCENT; Lt Gen Charles A. Horner, USAF, Commander, 9th Air Force/COMUSCENTAF; Lt Gen John J. Yeosock, USA, Commander, 3d Army/COMUSARCENT; VADM Stanley R. Arthur, USN, Commander, 7th Fleet/COMUSNAVCENT; Col Jesse L. Johnson, USA, COMUSOCCENT.

What was the Air Campaign Plan?

On 8 August 1990, two days after King Fahd of Saudi Arabia had approved the deployment of American forces to defend Saudi Arabia and one day after those forces began to deploy, President George Bush outlined U.S. objectives in the region. They were to (1) secure the immediate, unconditional, and complete withdrawal of Iraqi forces from Kuwait, (2) restore the legitimate government of Kuwait, (3) assure the security and stability of the Persian Gulf region, and (4) protect American lives.¹

On 25 August 1990, less than three weeks after the U.S. decision to commit troops to defend Saudi Arabia, Gen. H. Norman Schwarzkopf, Commander, U.S. Central Command (CENTCOM), briefed Gen. Colin L. Powell, Chairman of the Joint Chiefs of Staff (JCS), on the outlines of a four-phased plan to eject the Iraqis from Kuwait. Although the ground forces' concept of operations remained unclear, the concept of the air campaign had already evolved:

USCINCCENT's Intent

. . . We will initially attack into the Iraqi homeland using air power to decapitate his leadership, command and control, and eliminate his ability to reinforce Iraqi ground forces in Kuwait and Southern Iraq. We will then gain undisputed air superiority over Kuwait so that we can subsequently and selectively attack Iraqi ground forces with air power in order to reduce his combat power and destroy reinforcing units. . . .²

¹Address to the Nation Announcing the Deployment of United States Armed Forces to Saudi Arabia, in *Public Papers of the Presidents of the United States: George Bush, 1990* (Book II) (Office of the Federal Register, National Archives and Record Administration, 1991), p 1108. These objectives were a restatement of those put forward by the U.S. State Department on 6 August. UN Resolutions 660 and 661 of 2 and 6 August also contained the first two of these objectives.

²(S) Viewgraph from brfg. "Offensive Campaign: Desert Storm," Hq, Central Command, 24 Aug 1990, GWAPS, NA 208. Notice the use of the term "decapitate."

In the months that followed, increased forces became available for war, and planners developed specific elements of the air and ground campaign. The four-phase structure of the air campaign, however, remained unchanged: a strategic air campaign into Iraq, air supremacy over the Kuwait theater, preparation of the battlefield by attrition of the Iraqi Army, and air support for the ground attack. Turning this concept into reality would require a great deal of time and labor.

No single "air campaign plan" recognizable as such existed. Rather, the air campaign plan executed by Coalition forces at the outset of the Gulf War consisted of three elements:

- a broad statement of purpose, including the idea of a four-phased war;
- extremely detailed air tasking orders for the first two days of the war, plus additional staff work on the third day of operations; and
- a more diffuse set of expectations about how the air war would unfold and what it would accomplish against any given target set.

The air campaign plan was imbedded in the operations plan for all forces and consisted of an amalgam of thick scheduling documents, an extensive series of briefings, each slightly different from the last, and a set of intentions captured only sporadically on paper. Nonetheless, the result was a unified concept for applying air power against Iraq.

Precrisis Planning

The plan for using air power in Desert Storm had surprisingly little to do with planning done before August 1990. The Soviet threat and the nature of the theater had long shaped the expected role of air power in the defense of the oil-producing areas in the Gulf region. The distance of the theater from the United States and the lack of any in-place forces on the ground made airlift and sealift critical to any defense of the region. American planners expected air forces, land- and sea-based, to serve as the first line of defense in the early stages of a conflict, which might last months until large ground forces could arrive. In the early weeks of war in the Gulf, planners expected air power to interdict and delay the attacking ground forces, be those forces Soviet, Iranian, or Iraqi. On the basis of these

expectations, the planned use of air power was defensive, with little thought given to offensive employment or any other independent use of air power.

Until 1989, Southwest Asia was, in the global context of U.S. planning, a secondary theater; the United States would fight a limited, defensive campaign, conserving its resources for a far larger and more important struggle with the Warsaw Pact on Europe's central front. Furthermore, as in Europe, the offensive use of air power in a war involving the Soviet Union seemed to pose unacceptable risks of escalation. In October 1989, newly appointed General Powell, Chairman of the Joint Chiefs of Staff, directed General Schwarzkopf to concentrate planning for a Southwest Asia conflict on a scenario of regional conflict without Soviet involvement, not on operations in the context of a global superpower war. Furthermore, that planning would reflect a political assessment that Iraq, not Iran, had become the primary threat to regional stability. The demise of the Warsaw Pact would allow Central Command to draw on greater resources for planning than would have previously been available. As a result, the forces planned for a Southwest Asia contingency doubled and in some cases tripled. Staff officers had prepared a draft of the new plan, Operations Plan 1002-90, Defense of the Arabian Peninsula, by the spring of 1990. In the normal course of events, they would have completed an approved plan by the summer of 1991.³

Pre-August 1990 planning for the Persian Gulf, as for most regions, concentrated on the requirements for deploying forces over vast distances. Planners thought more about the means of moving the fighting and logistical units to the theater—a vast task—than about the tasks of the units once they got there. The sketchy operational planning that did exist envisaged three phases. During the first phase, deterrence, American forces would attempt to discourage an aggressor who had already demonstrated hostile intent. Air forces would arrive first on the scene; Air Force tactical fighter squadrons, airlift squadrons, aerial tankers and airborne command and control aircraft, two Navy carrier groups and one battleship battle group, and brigade-sized Army and Marine aviation

³(S) Notes, Col Bryan A Sutherland, USA, CENTCOM J-5, handwritten notes, 3 Oct 1990, GWAPS and AFHRA 00881768; (S) Fact sheet, "USCINCCENT OPLAN 1002-90-Arabian Peninsula," Col John L Buckley, USCENTCOM J-5-P, 1 Jun 1990, GWAPS and AFHRA 00881768, reel 23630; and (S/NF) USCINCCENT OPLAN 1002-90 Concept of Operations, 16 Apr 1990, pp 19-20, GWAPS, CHC 13.

assets would arrive within the first two weeks. A B-52 squadron and a third carrier battle group would follow shortly. During a second phase, defensive operations, the United States would gain air superiority against an attacking enemy, protect the air and naval bases used for debarking forces, and interdict enemy lines of supply and communication in order to disrupt the attacking force. In addition, air power would provide any necessary close air support. A third phase, counteroffensive operations, was anticipated after sufficient forces had assembled and the enemy's combat power had declined by an unspecified level of attrition. The specifics of this last phase received almost no treatment in the plan, other than a reference to the tasks of defeating enemy forces and regaining control of key facilities.⁴

Central Command leaders examined the draft operations plan in a command post exercise, Internal Look 90, that took place in July 1990 and ended just days before the Iraqi invasion of Kuwait. Central Command designed the exercise to test the draft plan and uncover potential difficulties in its execution. An important addition to the exercise force list were the Air Force's stealth aircraft, the F-117s. F-117s did not figure in the draft plan (their existence had only become public in November 1988), but theater commanders could now begin to tap them for regional operations plans. The exercise revealed several shortfalls: not enough precision-guided munitions, a shortage of aircraft tankers to accommodate the aircraft of the carrier battle groups, and difficulty obtaining timely bomb damage assessment for use in planning further air strikes.⁵

The exercise proceeded through its phases to counteroffensive operations when, on the final two days of game play, the National Command Authority granted players "cross-border authority." As a result, the staff ordered aircraft to strike several leadership and command and control targets in Baghdad.⁶ But these attacks differed greatly from those later

⁴(S/NF) USCINCCENT OPLAN 1002-90, second draft, 18 Jul 1990, Concept of Operations, pp 20-26.

⁵*Whirlwind War*, draft of Jun 1992, U.S. Army Center of Military History, Washington, DC, p 85, GWAPS, NA 304; (S/NF) USCINCCENT, *Desert Shield/Desert Storm and Internal Look 90 After Action Reports*, 15 Jul 1991, GWAPS, NA 9.

⁶(S/NF) Fact Sheet, Maj John Heidrick, 9 AIS, "9 TIS/INT Planning Procedures for Internal Look 90 and Operation Desert Shield," 4 May 1992, p 1, GWAPS, NA 267; (S/NF) USCINCCENT, *Desert Shield/Desert Storm, Internal Look 90 After Action*

carried out during Desert Storm. They came as the *final* element of the campaign rather than as its critical opening phase. Exercise-ending against the enemy homeland reflected the decades of planning for East-West conflict in Europe, in which such strikes were closely associated with the escalation to nuclear conflict. Furthermore, Central Command classified the Internal Look simulated attacks as "long-range interdiction," a term very different in its connotations from the "strategic targets"⁷ of Desert Storm. And finally, the concluding strikes of Internal Look in no way matched the weight and intensity of the air campaign that began on 16 January 1991.

Internal Look 90 did perform useful service in some areas, however. The targets selected by staff for the scenario served as a useful starting point for the eventual Desert Storm target list. Two lists were drawn up in the summer of 1990 for Internal Look: an Air Force Component Central Command (CENTAF) list and a Central Command composite list, using nominations from the Service components. Both lists are shown in Table 1.

Too much can be made of the difference between these early lists, some of which derived from the access of the Service components to specific target intelligence. However, two aspects of the lists are noteworthy: first, the emphasis by CENTAF on attacking the air defense system as a prelude to other attacks; second, the negligible attention of both lists to nuclear, biological, chemical, and Scud facilities. Planners lacked information on the location and extent of such facilities, which in any event were not central to the war envisioned in Internal Look 90. Furthermore, detailed information needed for actual mission planning did not exist for most of the targets nominated on the lists.

Internal Look 90 and the draft plan from which it flowed had a defensive purpose, and the planned air employment reflected this imperative. The list of aircraft missions provided in order of priority by Lt. Gen. Charles A. Horner, the CENTAF commander, carried no refer-

Reports, 15 Jul 1991, Appendix L, GWAPS, NA 9.

⁷In the planning of the Desert Storm air campaign, these targets were identified as "strategic" targets; in the mission reports accomplished after each mission, the strikes were identified as "interdiction."

Table 1
Internal Look 90 Target Lists⁸

Target Categories	CENTAF Target List	CENTCOM Joint Target List
Leadership	3	4
Command, Control & Communication	14	21
Air Defense	72	4
Airfields	37	58
Nuclear	1	0
Biological	1	1
Chemical	1	1
Military Production & Support	22	81
Electric	6	0
POL	22	19
Scuds	7	0
Republican Guard	0	0
Ground Forces	0	8
Lines of Communications	25	79
Naval Forces (Ports)	7	17
TOTALS	218	293⁹

⁸ (S/NF/WN) Target Study, 9 TIS, "Iraqi Target Study," 15 Jun 1990, GWAPS, NA-168; (S/NF/WN) Doc, "USCENTCOM Joint Target List," Tab A to Appendix 4 to Annex B to USCINCCENT OPLAN 1002-90, 27 Jun 1990, GWAPS, NA 41.

⁹ Installations listed under more than one category in the Joint Target List have been counted no more than once. For example, Al Basra Naval Base was listed 11 times. However, it was counted twice in this table, once as a naval installation and once as a naval headquarters.

ence to attacks on what came to be called the strategic targets of Desert Storm; the priorities did, however, anticipate the defensive planning performed in the early days of Desert Shield.¹⁰

Desert Shield Planning

Iraq's invasion of Kuwait on 2 August 1990 created a situation quite different from the scenario envisioned in Operations Plan 1002-90 (which anticipated 30 days warning of an invasion of Saudi Arabia). If anything, the change made the use of air power even more crucial. When General Schwarzkopf and General Horner laid out options for President Bush at a National Security Council meeting on 4 August, it was clear that all the early options involved air power. The initial land- and carrier-based air could arrive within days; twelve fighter squadrons, a bomber squadron, and two carrier battle groups could be in the region when only an airborne division and a Marine brigade would be available. Forces for a ground offensive, if necessary, would not be ready for seventeen weeks, and even deploying sufficient ground forces to establish a defense would take several weeks.¹¹ General Horner briefed the meeting on the planned employment of air power as envisioned by the operations plan: gaining air superiority, interdicting the attacking Iraqi forces, and defending the ports and rear areas. He also briefed a second plan of offensive retaliatory strikes against targets in Iraq, if Iraq used chemical weapons against U.S. or allied forces.¹² As forces began to deploy to the theater, the CENTAF staff developed employment plans for these two options.

The two initial options were captured in the format of air tasking orders (ATOs),¹³ the "Punishment ATO" and the "D-Day ATO." The

¹⁰(S) Ltr, Col Richard B. Bennett, USAF, Dir Combat Plans, subj: "Internal Look 90 COMUSCENTAF Air Guidance Letter," 24 Jul 1990. GWAPS, NA 163.

¹¹(S) Brfg, "USCENTCOM Preliminary Planning, 2-6 Aug 1990," GWAPS, NA 117.

¹²*Conduct of the Persian Gulf War*, p 40; (S) Ltr, Tactical Air Command Historian to 9th Air Force Historian, 12 Jun 1991, subj: General Horner Questions and Answers, with two attachments, GWAPS, CHP 13A.

¹³There was no complete operations plan or operations order in existence that captured the essence of the planning taking place. The air tasking order is the final distilled product of the planning involving objectives, aircraft sortie allocation, and target selection, issued in terms of a daily schedule of aircraft sorties matched with missions, targets, times, and all the coordinating instructions necessary for units to accomplish the

first plan of August 1990, the punishment ATO, may also be seen as the first of the true offensive plans. This ATO, an outgrowth of General Horner's briefing to the President on 4 August, involved a single retaliatory strike in reaction to the use of chemical weapons by Iraq. The targets (seventeen total) were economic (oil production and storage facilities and electric power generation), military (including the known chemical, nuclear, and biological facilities), and one political target—the presidential palace. The ATO assumed no accompanying ground attack. The objectives were punitive to discourage further Iraqi use of chemicals and were not assumed to be a part of any larger campaign; there was no mention of a next step if the punishment did not work.¹⁴ This effort soon gave way to the larger offensive air campaign, for which planning began in Washington during this same period. Meanwhile, Riyadh planners working on the D-Day ATO concentrated on the possibility of an Iraqi attack into Saudi Arabia and planned for the sorties envisioned in Operations Plan 1002-90—that is, to gain air superiority, attack the invading Iraqi forces, and defend key facilities in Al Jubayl, Ad Dammam, and Dhahran, the principal bases through which the deploying Coalition forces had begun to enter the theater.

The D-Day ATO as it existed in August 1990 represented a totally defensive air employment, based as it was on the inadequate number of U.S. ground forces in the region in August. Central Command's studies at the time indicated that it could not successfully defend the key facilities along the coast against an Iraqi assault until near the end of August, when the 82d Airborne Division and a Marine expeditionary brigade had arrived to protect these enclaves.¹⁵ As more ground and air forces arrived in the theater, the D-Day ATO expanded from its defense-only stance to include more offensive strikes, just as the draft operations plan had envisioned and the staff had practiced in Internal Look 90. Continually

specific tasks. Although a single day's ATO does not explain an air campaign, the term ATO is used here as it was often used at the time—as shorthand for the series of daily orders for air operations that executed a specific plan. The ATO itself is a controversial subject of the war, and further discussion of this subject is found in Chapter 5.

¹⁴The employment of this ATO seems to have anticipated an Iraqi Scud attack with chemical weapons. (S/NF) Hq, CENTCOM J-5 Plans *After Action Report*, Vol VI, Tab A, "U.S. Air Campaign Plan," Aug 1990, GWAPS, NA 259.

¹⁵(S/NF) Headquarters, CENTCOM J-5 Plans, *After Action Report* and Supporting Documents, Volume VI, Tab X, "Combat Analysis Group After Action Rpt," 21 Mar 1991, GWAPS, NA 259.

updated throughout the period of Desert Shield, the D-Day ATO also served as a focus of the overt planning for an air campaign. The true offensive plan, however, was not the D-Day ATO but a plan being developed by a special planning group, the "Black Hole," whose existence and planning was known to only a few on the Central Command and CENTAF staffs.¹⁶

Offensive Air Campaign, Phase I

Precrisis planning had called attention to deficiencies in basic intelligence information, had acquainted staffs with the region in which they would fight, and perhaps most important, had familiarized them with one another. But these efforts did not shape the Desert Storm air plan. The strategic purpose of the actual war that occurred—an offensive operation to liberate Kuwait and shatter Iraqi power rather than a defensive operation to protect Persian Gulf allies—was utterly different from that of precrisis planning. Furthermore, much of the Desert Storm air plan emerged from planning prepared by special and ad hoc organizations, whose existence no one had anticipated before the war.

Shortly after the Iraqi invasion of Kuwait, a group of Air Staff officers in the Pentagon began planning an air campaign designed to eject Iraqi forces from Kuwait. Col. John A. Warden III, the Air Staff's Deputy Director for Warfighting, supervised this effort. The group initially numbered six but quickly grew to more than one hundred officers from the Air Force and other Services, operating out of offices that were previously the facility of an Air Staff division called Checkmate; this ad hoc group itself became known as Checkmate. Warden and his Checkmate organization developed military objectives, a concept of operations, and a targeting scheme designed to accomplish the President's objectives using air power alone.

The initiative might have ended there had General Schwarzkopf not called the Air Force Vice Chief of Staff, Gen. John M. Loh, and asked

¹⁶(S/NF) Fact sheet, Maj John Heidrick, 9th AIS, Shaw AFB. "9 TIS/INT Planning Procedures for Internal Look-90 and Operation Desert Shield," 4 May 1992. GWAPS, NA 267 and in Continuity Book (S/NF), maintained by Capt Heidrick, 9th TIS containing miscellaneous reports, summaries, and charts located at HRA, Maxwell AFB, AL; (S) Intvw, Dr. Alexander Cochran with Brig Gen Buster Glosson, 12 Dec 1991, GWAPS Cochran files.

for help in planning an air option to retaliate against Iraq. General Schwarzkopf was not looking for an option to eject Iraq from Kuwait by air power alone, nor was he, as a theater commander, predisposed to ask for assistance from a Service staff. But at this time (8 August), he had few forces available in the theater and needed a way to retaliate against some new, hostile act by Iraq, such as the seizure of the American Embassy in Kuwait or a chemical weapons attack.¹⁷ The punishment ATO provided one such option, but he apparently saw this attack as an insufficient response and his regular staff as too burdened with managing the deployment to develop an alternative. He found Warden's ideas much more suitable.

The plan developed by Warden and Checkmate, named Instant Thunder, called for an intense six-day air campaign designed to incapacitate Iraqi leadership and destroy its key military capabilities. Warden's campaign was organized around "centers of gravity"—key elements of the enemy state and armed forces, the destruction or disabling of which would compel the enemy to yield to American wishes. The most important center of gravity was the ability of Saddam Hussein to lead and control his nation, so attacks on telecommunication sites and command centers would isolate him from the Iraqi people and his armed forces. Together with a national-level psychological warfare campaign directed against the Ba'athist regime, these attacks would disable or even fatally weaken the regime. Instant Thunder targeted Iraq's nuclear, chemical, and biological facilities and its national air defense system and airfields. Other targets included electric power, oil production, railroads, and military production. In all cases, however, the United States would strenuously avoid civilian casualties and, indeed, any long-term damage to the Iraqi economy. The United States would visibly demonstrate its intention to attack Hussein, not the Iraqi people. The plan had eighty-four targets (nineteen in the telecommunications set) to strike over six days. Initially, Warden planned

¹⁷Gen Schwarzkopf had first spoken with JCS Chairman Gen Colin Powell about the need for a retaliation plan. Since the Air Force Chief, Gen Michael Dugan, was out of town at the time, his request to the Air Staff went to Gen Loh. Intvw, Diane T. Putney, Center for Air Force History, with Gen H. Norman Schwarzkopf (USA, ret), 5 May 1992, GWAPS, NA 268.

to use only Air Force assets, including F-117 aircraft.¹⁸ Warden did not consider Instant Thunder a finished product but rather a good first cut.

The plan (which developed constantly from early August on) progressed through a number of versions during the ten days Warden briefed it to Air Force Headquarters and the Joint Staff before introducing it to the theater. The text of the briefing viewgraphs stopped just short of declaring that Instant Thunder alone would force Iraq to withdraw from Kuwait.¹⁹ The Checkmate planners appear to have believed that the conflict would require attacks on Baghdad and Iraq proper, and not solely, or even chiefly, on forces deployed in Kuwait. After Warden briefed the plan to General Schwarzkopf on 10 August, and General Powell on 11 August, General Powell directed that planners from the other Services and the Joint Staff join the effort. At this stage, too, the plan expanded to include the Navy and Marine Corps aircraft deploying to the region and the Navy's Tomahawk land attack missiles (TLAMs). The version of the plan received on 17 August by General Schwarzkopf retained Warden's and Checkmate's concepts but included more than Air Force aircraft and, reflecting the Joint Staff sponsorship, bore the logo of the Joint Chiefs of Staff. Instant Thunder offered the American high command the only offensive option it would have for months. The plan, however, did not receive universal support; General Horner (serving as Central Command Commander, Forward, in General Schwarzkopf's stead), gave it a far more critical reception than it had received in the United States.

General Horner thought the plan seriously flawed in its operational aspects and disapproved of its relative neglect of the Iraqi forces in Kuwait. To produce a more acceptable plan, Horner selected Brig. Gen. Buster Glosson, an Air Force officer then on another assignment in the region, to direct a secret planning effort for an offensive air

¹⁸(S) Brfg. "Instant Thunder," "Iraqi Air Campaign," and like names, Aug 1990, contained in GWAPS, CHSH 5 and 7. Warden was predisposed to focus on the command element as the true center of gravity in any case [John A. Warden III, *The Air Campaign* (Washington: National Defense University Press), 1988, pp 51-58], but the personality of Saddam Hussein made this focus seem particularly appropriate.

¹⁹Versions of the briefing included the following formulation: . . . "degrade Iraqi will and military capability . . . to conduct defensive operations in Kuwait." (8 Aug); "Create conditions leading to Iraqi expulsion from Kuwait." (11 Aug); "Peninsula nations would have combat capability to deal effectively with residual Iraqi forces." (17 Aug) GWAPS, CHSH 5 and 7.

campaign.²⁰ Horner retained in the theater several of Warden's planners who had accompanied him and thereby some of Warden's concepts. The plan that emerged from Glosson's efforts retained the same target sets, the same focus on Iraqi leadership, and the same intent of isolating Saddam Hussein from the Iraqi people and his forces. Instead of constituting an entire campaign, however, the revised plan became the first phase of a more general plan to eject Iraqi forces from Kuwait.

On 25 August 1990, General Schwarzkopf briefed General Powell on a four-phase plan, code named Desert Storm, to eject Iraqi forces from Kuwait (a briefing from which the quote found at the beginning of this chapter was taken). The first phase, called the strategic air campaign, was essentially the Instant Thunder plan, with an added aim of preventing reinforcement of Iraqi forces in Kuwait; the second phase would gain air superiority over Kuwait; the third phase consisted of air operations to reduce Iraqi ground forces capability before the ground attack; and the fourth phase, which still required much work, was a ground attack into Kuwait—a planning concept identical to the one executed the following January and February. Schwarzkopf estimated that he could execute the first three phases by early October but could not conduct the ground phase until December.²¹

The development of the strategic air campaign, now Phase I in a larger plan, was a highly classified process. The Special Planning Group, directed by General Glosson, operated in secrecy. In addition to normal security concerns, the high classification of the development project stemmed from American and Saudi sensitivity to the concerns of friendly Arab governments that threats of offensive military action might impede a negotiated settlement. The Special Planning Group, nicknamed the Black Hole, included Army, Navy, and Marine Corps representatives, but Air Force officers predominated. Most of the latter came from outside the CENTAF staff. By mid-September, representatives from Great Britain's Royal Air Force and later from the Royal Saudi Air Force had joined the effort. By 2 September, the Black Hole had prepared and General Horner approved a CENTAF operations order for Phase I.

²⁰(S) Transcript, Lt Gen Horner's taped responses to written questions by CMSgt John Burton, CENTAF Historian, Mar 1991, GWAPS, CHP 13A.

²¹(S/NF) Brfg Viewgraphs, "Offensive Campaign: Desert Storm," Hq, Central Command, 24 Aug 1990, GWAPS, NA 208.

General Schwarzkopf then heard the briefing (3 September) as did General Powell (13 September), Secretary of Defense Dick Cheney, the Joint Chiefs of Staff, President George Bush, and members of the National Security Council (10 and 11 October). At these meetings, less developed plans for Phases II and III were briefed; Glosson and the Black Hole continued to concentrate on Phase I. The CENTAF staff, which prepared the daily air tasking orders and had custody of the D-Day ATO, worked on plans for the close-in battle in Kuwait, plans that would form the basis for Phase III and the air portion of Phase IV. As noted this CENTAF planning staff operated in isolation from the Black Hole, with little knowledge of its plans.

The strategic air campaign of Instant Thunder envisioned approximately 150 attack aircraft; the plan briefed to the President in October called for more than 400 attack aircraft, with another 300 (half of them helicopters) reserved for defense against an Iraqi attack and to initiate the third phase.²² Nonetheless, the concepts of the first phase remained remarkably constant.

According to the operations order for Desert Storm, there were six military objectives, and Phase I was to focus on three "centers of gravity":²³

Theater Military Objectives

- Attack Iraqi political/military leadership and command and control;
- Gain and maintain air superiority;
- Sever Iraqi supply lines;
- Destroy chemical, biological, and nuclear capability;
- Destroy Republican Guard forces; and
- Liberate Kuwait City.

²²(S) Operations Order, COMUSCENTAF Operations Order "Offensive Campaign-Phase I," 2 Sep 1990, GWAPS, BH 8-133; (S) Brfg slides in "General Glosson's Brief," GWAPS Box 3, Folder 60.

²³(S) USCINCCENT OPORD 91-001 for Operation Desert Storm, 16 Jan 1991, paras 1D, 3B and 3C, GWAPS, NA 357.

Centers of Gravity

- Iraqi National Command Authority;
- Iraq's chemical, biological and nuclear capability; and
- The Republican Guard Forces Command.

Phase I Targeting

Phase I, the strategic air campaign, called for attacks against twelve interrelated target sets²⁴ in order to "result in disruption of Iraqi command and control, loss of confidence in the government, and significant degradation of Iraqi military capabilities."²⁵ First, command of the air was to be gained by attacks on the Iraqi strategic air defense system and air-fields. The most important centers of gravity were leadership and command, control, and communications facilities. To eliminate long-term Iraqi offensive capabilities, the nuclear, biological, and chemical weapons research, production, and storage facilities, and the Scud missiles, launchers, and production and storage facilities were targeted. The key elements of the Iraqi armed forces and their supporting industries made up the remainder of the target sets: the Republican Guard forces, military storage and production sites, naval forces and ports, railroads and bridges, electricity production, and oil refining and distribution facilities. To simplify its task, the Black Hole assigned each target category an alphabetic identifier (e.g., L for leadership, SAD for Strategic Air Defense) and a number for each target in that category (e.g., SAD01, L15, etc.). This identification system would cause some confusion during the air campaign when targeting and intelligence communities outside the Black Hole used a more complicated but standard identification system. Furthermore, the simple Black Hole system developed an ambiguous categorization of targets—naval targets, for example, included at least one air defense site and one petroleum terminal.

²⁴The term strategic air campaign means simply those activities planned as part of Phase I. The term was a controversial one at the time, and as of this writing discussions continue within the U.S. military concerning the appropriateness of the terms "strategic targets" and "air campaign."

²⁵(S) OPORD 91-001, para 3C.

The original Instant Thunder plan had begun in August 1990 with a total of eighty-four targets to be struck over a six-day period, and although the target sets remained essentially the same, the total number of targets grew during the fall of 1990. The growth in numbers is shown in Table 2. The August date corresponds to the final plan of Warden and Checkmate as it was presented to General Horner; the December date indicates the Phase I plan as it was in its final stages before execution.

The growth in numbers reflected sharply increased knowledge of the Iraqi military forces and leadership structure gained after the United States focused its reconnaissance capabilities on Iraq in the summer and fall of 1990. The growth also came about as an indirect consequence of the increased number of strike aircraft available and the resulting ability to target a larger portion of the Iraqi air defense and military support structure. Throughout the war, in fact, the target list would continue to grow. The intensity of the planned campaign also grew, because although its duration remained constant (six days), the number of aircraft available for its prosecution continuously increased.²⁶

The air planners' first priority was gaining command of the air. This goal was a basic tenet of air operations, and its achievement would generate at least three specific advantages in the war. First, the incapacitation of airfields and the air defense system would allow sustained prosecution of attacks against the other target sets. Second, command of the air would prevent Iraqi offensive strikes against Coalition forces, in particular strikes delivering chemical weapons. Third, the Coalition would prevent Iraqi reconnaissance flights that might uncover the shift of ground forces to the west, the surprise to be sprung at the start of the ground offensive.²⁷ The planners therefore directed their most intense and immediate attention to destroying the Iraqi defense system through the use of F-117s, other aircraft employing antiradiation missiles to attack radar systems, and a vast array of electronic countermeasures.

The attacks against the nuclear, chemical, and biological weapons and Scud facilities served short-term and long-term objectives. In the short

²⁶The operations order stated 6 to 9 days. (S) OPORD 91-001, para 3A, 16 Jan 1991.

²⁷(S) MR, Lt Col David A. Deptula, USAF, subj: Observations on the Air Campaign Against Iraq, Aug 1990-Mar 1991, 29 Mar 1991, p 3, GWAPS, Safe #12, D-01.

Table 2
Growth of Targets, August to December 1990²⁸

Target Sets (symbols used by the Special Planning Group and their explanations)	21 August	20 December
SAD (strategic air defense)	10	27
C (chemical, nuclear, and biological facilities)	8	20
L (leadership)	5	27
CCC (command, control and communication sites)	19	30
E (electric power)	10	16
O (oil facilities)	6	8
RR (railroads and bridges)	3	21
A (airfields)	7	25
N (naval ports and facilities)	1	4
MS (military support facilities)	15	46
SC (Scud facilities)	N/A	13
RG (Republican Guards)	N/A	0
Totals	84	237

Notes: Highway bridges were added to the category that was originally railroads alone; Scud facilities were counted as part of the chemical, nuclear, and biological category in August; the Republican Guard was a new target set; specific targets were added at a later date.

²⁸(S/NF) Brfg, Joint Chiefs of Staff, "Iraqi Air Campaign, Instant Thunder," GWAPS, CHSH 5-3; (S) Brfg, CENTAF/CC to SECDEF in "General Glosson's Brief."

term, their destruction would prevent the employment of such weapons in the Gulf War. Planners believed that the Iraqi nuclear weapons program had not gone beyond research, but they believed Iraq fully capable of using both chemical weapons and Scuds.²⁹ In the long term, the objective of security and stability in the Persian Gulf required eliminating Iraqi weapons of mass destruction along with the Scuds that could serve as their delivery means. Planners knew that the Iraqi ballistic missile force had mobile launchers, some number of which would escape destruction and fire their missiles. But although the Black Hole had planned since August 1990 to attack the fixed Scud sites, neither that group nor anyone else had devised, before the war, a search-and-destroy scheme for dealing with them. The planners in the Black Hole, like CENTCOM's leaders, regarded Iraqi ballistic missiles (even with chemical warheads) chiefly as nuisance weapons that might cause political difficulties for the alliance (particularly if Israel were to retaliate against the Iraqis). They viewed the missiles as posing little tactical or operational threat to the Coalition and intended to reduce the offensive threat they represented by attacking fixed launch sites, support bases, production facilities, potential hide sites, and support facilities for mobile launchers, but not the launchers themselves.³⁰

Military support facilities and naval ports and facilities were natural target sets. Several other target sets (railroads and bridges, electric power production, and oil facilities), while undeniably forming a part of a country's military power, also served a country's nonmilitary economic power and its civilian populace.³¹ Here, planners attempted to affect the military support provided by these entities while limiting the damage in other respects. The Black Hole did not, however, attempt to avoid inconvenience to the Iraqi population. Rather, they wished to inflict disruption and a feeling of helplessness on the Iraqi public without bringing about severe suffering—all in the hope of weakening Hussein's grip. As a result, planning for attacks on the industrial power of the country had a dual nature. On the one hand, the objectives were to “cripple production” and

²⁹(S) Brfg, Maj Gen Robert Johnston, CENTCOM Chief of Staff, to Joint Staff and National Command Authority, "CENTCOM Offensive Campaign, "10 and 11 Oct 1990, in rep (S) CENTCOM J-5 Plans, Augmentation Cell, *After Action Report* [Vol IX SAMS], Tab C, 28 Feb 1991, GWAPS, NA 259.

³⁰(S) Target list (with objectives for each target category, including Scuds), GWAPS, BH, Other Documents, Folder 8.

³¹Many of the telecommunications targets would also fall into this category.

"complicate movement of goods and services."³² On the other hand, planners harbored an "intent to convince the Iraqi populace that a bright economic and political future will result from the replacement of the Saddam Hussein regime . . ." and that "execution planning will emphasize limiting collateral damage and civilian casualties and preserving the Iraqi and Kuwaiti capability to quickly reconstitute their economies."³³ To comply with this guidance, targeting attempted to distinguish between short-term and long-term damage to electric power generation and oil facilities. For oil targets, this meant that Coalition aircraft would hit oil refining and storage facilities, but not oil production facilities. Within the refinery target subset, aircraft would hit distribution points, not cracking towers. For electric power targets, they would strike transformers, which were thought to take months to repair, instead of the generator halls, which were thought to take years to repair.³⁴

Attacks against leadership and command and control had political and military dimensions. Separating the national leadership in Baghdad from the military forces in the field would delay the coordination of military operations and show the Iraqi forces the powerlessness of their leaders. Planners also hoped for a more direct political effect. If Saddam Hussein could not communicate with the Iraqi people, he could not propagandize against the United States and its allies, mobilize the country for war, or court world opinion. As a result, the air campaign targeted radio and television transmitters, relay stations, telephone and telegraph facilities, and military command posts. Also attacked, in addition to facilities that might house Saddam Hussein, were the buildings of the Ministry of Defense, Ba'ath Party headquarters, and similar sites. Planners counted most on these strikes to end the war by air power alone. The strikes, in

³²(S) Brfg, Joint Chiefs of Staff, "Iraqi Air Campaign Instant Thunder," 17 Aug 1990, GWAPS, CHSH 5-3; (S) Operations order, COMUSCENTAF Operations Order Offensive Campaign-Phase I, 2 Sep 1990, p 4.

³³(S) COMUSCENTAF Operations Order, Offensive Campaign-Phase I, 2 Sep 1990, pp 3-4.

³⁴There were no prewar limitations on striking bridges and railroads, though some limits were instituted during the war. This chapter will not go into the effectiveness of this guidance, but later chapters will. For instance, weapons and aircraft accuracy limitations sometimes did not allow such discrimination, and when Iraq began to dump oil into the Gulf and employ oil-fired trenches as part of their defenses, some of the pumping stations in southern Iraq and Kuwait were attacked. (Glosson intvw, 12 Dec 1991, GWAPS Cochran files; Deptul: intvw, 8 Jan 1992.)

coordination with others, would not just neutralize the government but change it by inducing a coup or revolt that would result in a government more amenable to Coalition demands. The final Central Command operations plan did not stress these intentions, which appeared most forcibly in the CENTAF operations order of September 1990: "When taken in total, the result of Phase I will be the progressive and systematic collapse of Saddam Hussein's entire war machine and regime."³⁵

Planners hoped that the air campaign would end in the removal of Saddam Hussein but did not make the death or capture of Saddam Hussein a specific objective. In fact, Generals Powell and Schwarzkopf made statements disclaiming such a goal at the beginning of the air campaign.³⁶ Before the war, military leaders worried that targeting Saddam Hussein might contravene Executive Order 12333, which prohibits U.S. Government involvement in "assassination."³⁷ In addition, the United Nations resolutions around which the Coalition had coalesced said nothing about eliminating Saddam. Explicitly setting goals that went beyond those of the United Nations would have necessitated complex and possibly counterproductive negotiations with the allies.³⁸ Finally, and perhaps most important, there was no certainty that strikes aimed at killing Saddam Hussein would have their intended effect. Officials remembered the difficulties in tracking down Manuel Noriega during

³⁵(S) COMUSCENTAF Operations Order, 2 Sep 1990, p 4.

³⁶Gen Powell, News Brfg, 16 Jan 1991 (transcript released by the Office of the Assistant Secretary of Defense for Public Affairs), p 5; and Gen Schwarzkopf, CENTCOM Brfg, 18 Jan 1991 (transcript released by the Office of the Secretary for Public Affairs), p 4.

³⁷Executive Order 12333—United States Intelligence Activities, 4 Dec 1981, in Office of the Federal Register, National Archives and Records Administration, *Codification of Presidential Proclamations and Executive Orders* (Washington, 1989), p 647.

³⁸President Bush, "Remarks on the Nomination of Edward R. Madigan as Secretary of Agriculture and a Question and Answer Session With Reporters," 25 Jan 1991, in *Weekly Compilation of Presidential Documents*, 28 Jan 1991, p 80; Vice President Quayle, cited in "Quayle on Hussein: 'He is totally irrational,'" *U.S. News & World Report*, 18 Feb 1991, p 27; and Robert Kimmitt, transcript, American Enterprise Institute, "The Gulf War Conference," 7 Dec 1991, p 293.

Operation Just Cause the previous year and hesitated to specify an outcome that aerial bombing simply could not ensure.³⁹

The political effects of the attacks on Iraq remained of concern throughout the planning effort. The operations plan included rules prohibiting attacks on cultural and historic sites, hospitals, mosques, civilian population centers, and other nonmilitary structures, in accordance with any military operation.⁴⁰ "Anything which could be considered as terror attacks or attacks on the Iraqi people will be avoided."⁴¹ A joint no-fire target list dated September 1990 was updated just before the war and then revised several times during the war. The State Department and the intelligence agencies contributed to the list, which included archeological sites, sites of special significance to the Islamic religion, foreign embassies in Baghdad, and camps thought to be holding Kuwaiti prisoners of war.⁴² Finally, just two days before the beginning of the air campaign, Secretary of State James Baker and Under Secretary of State for Political Affairs Robert Kimmitt went to the Pentagon to make a final examination of the target list with Cheney and Powell, and, according to Kimmitt, "It was very clear to both Secretary Baker and me . . . that those political considerations that had been expressed, both at the Cabinet level and [in the NSC Deputies Committee], had been well taken into account, and we both left the meeting very comfortable from a political perspective."⁴³

The Republican Guard received particular attention in Central Command planning, enough to have it specified as one of the target sets in the Phase I plan. Planners identified the Republican Guard as a center of

³⁹Robert Gates in "The Gulf Crisis: The Road to War," Program Three, p 19; Gen Colin L. Powell, transcript of News Brfg, 17 Jan 1991, p 6; and Gen H. Norman Schwarzkopf, in Hearings before the Committee on Appropriations, House of Representatives, *Department of Defense Appropriations for 1992*, Part 2, 102d Cong, 1st sess (Washington, 1991), p 277.

⁴⁰(S) Operations plan, Hq, U.S. Central Command, Combined Operation Desert Storm, 17 Jan 1991, Appendix 4 to Annex C, "Rules of Engagement," GWAPS, CHC 18-1.

⁴¹(S) COMUSCENTAF Operations Order, 2 Sep 1990, p 3.

⁴²(S) Msgs. USCINCCENT, subj: USCINCCENT Joint No-Fire Target List for Desert Shield, 14 Sep 1990, GWAPS, CHSH 100-26; and USCENTAF, subj: Joint No-Fire Target List, 16 Feb 1991, GWAPS, BH 2, Section 4.

⁴³Transcript, American Enterprise Institute, "The Gulf War Conference," 7 Dec 1991, p 236.

gravity of the campaign and a priority target of the air campaign. Not only did the Guard serve as the strategic reserve of the Iraqi forces in Kuwait, it also provided essential support to Saddam Hussein's regime. Schwarzkopf's planners intended to rout them so that they could not help Saddam Hussein retain order in the country. The operations order directed that the roads and rail lines south of Basra should be blocked in order to prevent the withdrawal of the Republican Guard forces.⁴⁴ While the Guard forces were seen as a target that had to be dealt with in Phase I of the air campaign, that issue became moot when, because of the number of Coalition aircraft available, the first three phases of the air campaign began at essentially the same time.

Planning for Phases II, III, and IV

The planning for the second, third, and fourth phases of the air campaign dealt with the Iraqi forces in the Kuwait theater. Initially deemed unnecessary by Warden and the Instant Thunder plan, attacks on these forces came to play a much larger role once the plan got to the theater. Besides being a part of the offensive campaign that became the Desert Storm plan, attacks on Iraqi forces in the Kuwait theater received attention during the Fall of 1990 in the planning for a contingency in which Iraq attacked Saudi Arabia. On 14 August, Central Command and Saudi officials formed the U.S.-Saudi Joint Directorate of Planning (JDOP) at the Saudi Ministry of Defense headquarters in Riyadh to develop combined operations plans. The JDOP's first product, Combined Operations Order 003, published on 20 August, assigned CENTCOM forces missions in concert with Saudi and Coalition regional forces to defend Saudi Arabia as far forward as possible. The concept of operations had Saudi forces establish a picket line close to the northern border while U.S. forces shielded Jubayl and Ad Dammam/Dhahran to protect deploying U.S. forces at those major airports and seaports of debarkation.

The JDOP continued its planning efforts throughout Desert Shield and Desert Storm, publishing the final plan for the defense of Saudi Arabia on 29 November 1990, but the locus of planning lay elsewhere. While the JDOP produced three other combined operations plans dealing with the occupation and defense of Kuwait, it served chiefly as a forum to

⁴⁴Operations Order 91-001, para 3.E.2.b.2; Glosson intvw, 12 Dec 1991, GWAPS Cochran files.

identify and resolve Coalition problems and, perhaps more importantly, it provided a conduit for rapid access to Saudi policymakers.⁴⁵ Offensive planning took place within Central Command: the Black Hole was developing Phase I, and CENTAF and CENTCOM staffs were developing plans for preparing the battlefield and supporting the ground attack. A CENTAF reorganization in December 1990 formally merged the Black Hole with the other elements of the CENTAF planning staff. At this time, all phases of the air campaign came together in the Desert Storm Operations Plan.⁴⁶

Planners made Phase II, Air Superiority in the Kuwait Theater, a separate phase only at General Schwarzkopf's suggestion—most of the air planners viewed the Iraqi air defense system as a whole, including the Kuwait theater—and this phase received little special elaboration. Phase III, Battlefield Preparation, however, called on air power to destroy ground forces to a degree not heretofore planned for any air force.

From early August 1990, CENTCOM leaders assumed that Iraqi forces would outnumber those of the Coalition, and that a successful attack into the Kuwait theater would require an extensive preliminary air attack. In the words of one of the earliest briefings on this subject, "... therefore must have heavy air attrition prior to ability to wage successful offense."⁴⁷

As early as 14 August, General Schwarzkopf's combat analysis group concluded that for a Coalition offensive to be successful with a single corps, the air campaign would first have to achieve fifty percent attrition of enemy ground forces.⁴⁸ General Glosson first discussed the fifty-

⁴⁵(S) Operations plan, Hq. U.S. Central Command and Joint Forces and Theater of Operations, Combined OPLAN for Defense of Saudi Arabia, 29 Nov 1990, GWAPS, CHC 18-4; (S/NF) USCENTCOM J5 Plans, *After Action Report*, pp 5-6, GWAPS, NA 259.

⁴⁶The planning organizations were brought together, but the existence and specifics of Phase I remained a closely held secret until just prior to the air campaign's initiation. Horner Intvw, 4 Mar 1991.

⁴⁷(S) USCENTCOM Brfg, "Preliminary Planning," 2-6 Aug 1990, GWAPS, NA 117.

⁴⁸(S) Rpt, Combat Analysis Group, 21 Mar 1991, in Vol VI of CENTCOM J-5 Plans, *After Action Report*. The Bush administration's November decision to double the forces for a two-corps ground offensive did not change the calculations because intelligence reported that Iraq had also deployed more forces to the Kuwait theater.

percent goal in September with Col. Joe Purvis, chief of a special group of Army planners that Schwarzkopf had recruited from graduates of the Army's School of Advanced Military Studies at Fort Leavenworth. No one really knew what would constitute a measurable fifty percent attrition of combat effectiveness, however. Initial planning called for attrition of troops and all major pieces of equipment, but CENTCOM planners later narrowed these indicators to tanks, armored personnel carriers, and artillery. Moreover, the attrition was left as a theaterwide goal, not attached to specific divisions or areas of the theater.

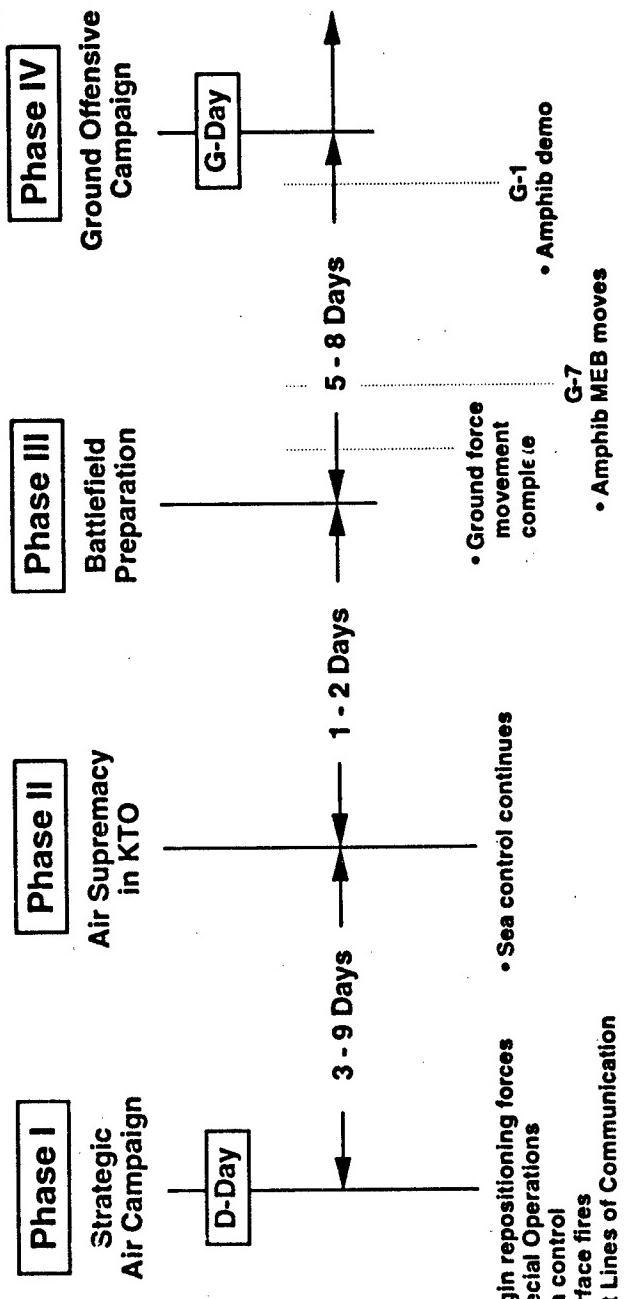
CENTAF planners, supported by Air Staff calculations, divided the air attacks on the Iraqi ground forces into two parts: those directed against the Republican Guard and those aimed at the remainder of the army in Kuwait. The planners earmarked higher performance aircraft (F-16s, F/A-18s, F-15Es, F-111Fs) for attacks against the Republican Guards, reserving the A-10s, AV-8Bs, and attack helicopters for the divisions in Kuwait. Attrition calculations assumed 600 sorties a day against each of the two parts of the Iraqi Army, relying primarily on precision munitions (but not laser-guided bombs—that innovation occurred during the air campaign) and various cluster munitions to create the attrition. On the basis of these criteria, General Glosson briefed General Schwarzkopf in December 1990 that air power could achieve the desired fifty percent attrition in five days against the Republican Guards and in approximately twelve days against the remainder of the forces in Kuwait.⁴⁹ Schwarzkopf not only accepted these attrition estimates, he reduced the time available, issuing an operations plan two weeks later that specified eight days for Phase III (see Figure 9).

Some flexibility returned in the operations order issued on 16 January for the campaign; in it, the duration of Phase III was left "to be determined."⁵⁰ The requirement for 50 percent attrition made the ground

⁴⁹(S) Brfg to the CINC, Phases II and III, 1 Dec 1990, in "Gen Glosson Briefing." Subsequent to this briefing, the Iraqi Army in the Kuwait theater continued to increase in amount of equipment, but so too did the Coalition air forces. Coalition air did not attain a level of 600 strikes a day in the Kuwait theater on a sustained basis until three weeks into the air campaign. For the first two weeks, air strikes against Iraqi ground forces averaged just over 300 a day.

⁵⁰(S) USCENTCOM OPLAN Desert Storm, 16 Dec 1990, p 13, AFHRA 269602; (S) USCINCCENT OPORD 91-001, 17 Jan 1991, p 6.

Figure 9^{s1}
Phases of Desert Storm Campaign Plan



^{s1}(S/NF) originally (TS/NF/SPECAT). USCINCCENT, U.S. OPLAN Desert Storm, 16 December 1990, np. GWAPS, CHC 18-2.

campaign depend on unprecedeted airpower success in destroying an army. Air power had an enormous task in Phase III alone—to destroy approximately 5,000 pieces of dug-in and defended Iraqi equipment. And these were not the only targets planned for attack in the Kuwait theater. The U.S. Army, Marine Corps, and other Coalition ground force components could all nominate targets such as Iraqi Army command posts, supply and ammunition depots, communications sites, and troop concentrations, to name just some of the more prominent ones. In other words, while the attrition calculations seem to have anticipated that the air planners would have a free hand in focusing the air attacks on Iraqi equipment, such a notion was counter to the Central Command target nomination system. Coalition ground units sought equipment attrition of course, but they sought that attrition along with the destruction of other elements of the Iraqi Army—all before a ground attack.

If all went as envisioned, planners estimated that the final phase, Phase IV, ground offensive operations, would commence several weeks after the launching of Desert Storm. The objectives for this phase were to liberate Kuwait, cut critical lines of communication into southeast Iraq, and destroy the Republican Guard in the Kuwait theater. The ground attack would be "combined with continuous B-52 strikes, TACAIR (tactical air) attacks, and attack helicopter operations." In anticipation of the main attack, "The bridges, roads and rail line . . . will be cut to block withdrawal of RGFC and to form a kill zone north of Kuwait."⁵²

Planners intended to provide close air support (CAS) for ground forces by using a "Push CAS" system. Flights of aircraft would arrive at locations within the anticipated target areas continuously, sometimes as frequently as every seven minutes. Without waiting for a ground commander to request support, the aircraft sorties were "pushed" to his location. If the commander had no need for the aircraft, they would orbit for a short time, then proceed to attack a planned back-up interdiction target, and another flight of aircraft would arrive to fly in orbit at the commander's location. Aircraft were to strike ground targets under the control of the tactical air control party, naval gunfire liaison team, or an airborne forward air controller.⁵³

⁵²(S) Coalition Combined OPLAN, pp 6-7; (S) USCINCCENT OPLAN Desert Storm, pp 13-14.

⁵³(S) Coalition *Combined OPLAN*, 17 Jan 1991, p C-6-2.

Targeting in the Kuwait theater during the prosecution of both Phases III and IV employed "kill boxes" to orient the attacking aircraft. The theater was divided on the map into squares (the so-called kill boxes), thirty nautical miles on a side, reflecting an already existing Saudi map overlay system. The squares (subdivided further into four fifteen-by-fifteen-mile squares) became the operating areas for attacking aircraft. Sometimes the aircraft flight had a designated target within the kill box; at other times the aircraft flight was left to find the most appropriate target within the area.

The Final Plan

A final element of the air campaign came together before the campaign's initiation. Aircraft from U.S. European Command had been positioned at Incirlik Air Base in Turkey in hopes that the Turkish government would permit air operations from its territory. While not critical to the success of the campaign, attacks from Turkey would divert Iraqi attention to the north and perhaps prevent the movement of more forces into the Kuwait theater. Turkey gave its approval to the U.S. request just hours before the beginning of the air campaign, and the aircraft based at Incirlik, known as Joint Task Force Proven Force, added almost one hundred additional combat aircraft to the air campaign. These aircraft supplemented the Phase I strikes, hitting air defense, chemical weapons, military supply, and industrial targets.⁵⁴ Black Hole planners did not count on the Turkish-based force until the war broke out.

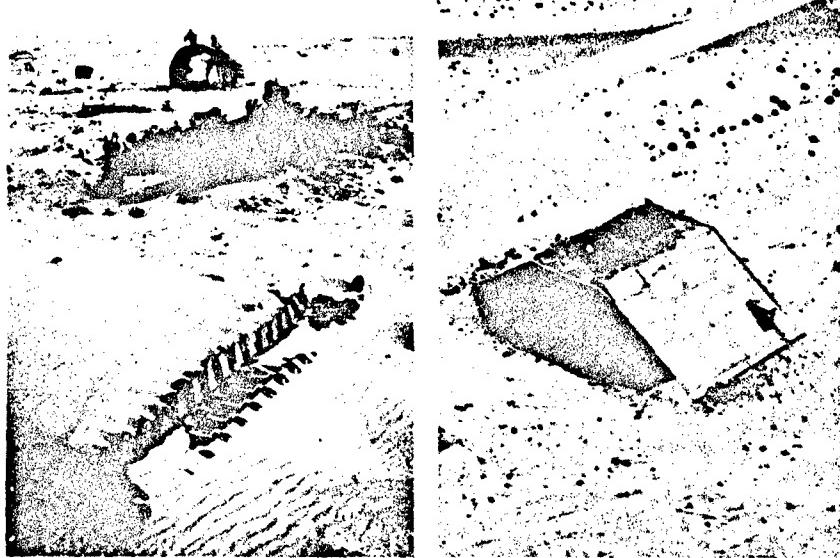
In December 1990, the planning efforts of the strategic air campaign came together with the planning for subsequent phases, and a combined operations plan emerged. The specific nature of Phase I of the plan and when it would begin remained closely held secrets until just before its initiation, so much so that most non-United States Coalition air forces could not be included in the opening attacks. The size of the Coalition air force allowed considerable flexibility in the air assets assigned to the different segments of the air campaign, and the numbers also permitted the first three phases to begin almost simultaneously. By 15 January, the Coalition air forces comprised more than 1,000 fixed-wing attack aircraft

⁵⁴(S) CMSgt Jerome E. Schroeder and SMSgt Thomas L. Raab, *History of Joint Task Force Proven Force* (Office of History, Hq, USAFE, 1991), pp 50-54.

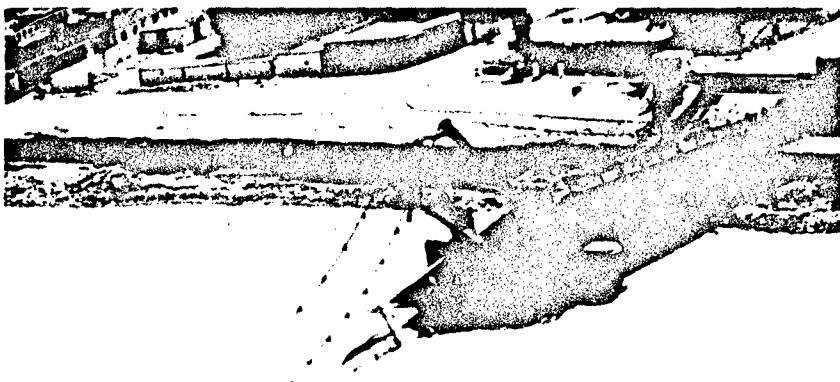
and another 800 air defense fighters and electronic combat aircraft to prosecute the air campaign.⁵⁵

When the air campaign began on 17 January 1991, air planners and commanders were confident. At a relatively low cost—one hundred or so losses maximum—they thought that the ambitious objectives set in the operations plan could be met. They were concerned about the possibility of a preemptive Iraqi attack, but thought that only a few enemy aircraft would penetrate Coalition defenses. Chemical warfare posed a threat, but less to air than to ground forces. Planners had little doubt that within a month, the Iraqi Army would flee Kuwait or, more likely, lie shattered in place, that Iraqi military industry and the Iraqi Air Force would be destroyed, and that Saddam Hussein's grip on Iraq would be, if not removed, weakened beyond repair.

⁵⁵Viewgraph, Gen Horner Briefing to the Secretary of Defense, 20 Dec 1990, in "General Glosson Briefings."



(Left) Remains of an Iraqi tank destroyed most likely by a laser-guided bomb. (Right) Aircraft shelter pierced by a laser-guided bomb with a penetrating warhead. (Photo taken by GWAPS Kuwait Battlefield Survey Team.) (Below) Destroyed bridge at Nasiriyah, Iraq.



What Did the Air Campaign Accomplish?

The Survey examined the Iraqi target base identified in the previous chapter, measuring effects and effectiveness of the air campaign against the objectives set by the Coalition. That target base included the fixed targets that CENTAF's Special Planning Group divided into twelve target categories¹ and Iraqi aircraft, ships, mobile missiles, and the Iraqi Army deployed in the Kuwait theater. As a way of dealing explicitly with the various objectives and target sets, the Survey considered the air campaign as having three major components: control of the air, strategic attacks, and air attacks on surface forces. Although considered separately, these three components obviously reinforced one another in a variety of ways.

In assessing the effectiveness of air power against the various "target sets" devised by air campaign planners, it should be noted that many sets overlapped. Attacks against command and control, for example, affected the ability of the Iraqi leadership to function; attacks against electrical power facilities forced air defense system components to resort to backup generators, which are less reliable and more prone to voltage fluctuations than normal power supplies. Furthermore, most target categories used by Black Hole planners to structure the air campaign did not constitute homogenous sets. For example, they put the Al Kharhk telephone switching facility in Baghdad, one of the most important telecommunications facilities in Iraq, in the command, control, and communications category. Another important telephone exchange, however, the so-called AT&T building in downtown Baghdad, ended up in the strategic air defense category.²

Defining Effectiveness

The Survey attempted to gauge the effectiveness of air power at the operational and strategic levels in the Gulf War; it focused less on the performance of particular weapon systems than on overall results mea-

¹See Chapter 2 (Table 2) for a list of these target categories, hereafter referred to as the Black Hole categories.

²(S) Master Target Folder, GWAPS, BH 2-23; (S) CHECKMATE Intelligence Target Files, "Baghdad AUTO MPUR-RADREL TERMINAL," GWAPS, CIT 684.

sured against actual military and political objectives. GWAPS had no direct access to sites in Iraq nor Iraqi records other than those captured in the Kuwait theater during the war. Visitors to Iraq (particularly United Nations inspections teams) provided useful information, but much remains uncertain. As a result, many of the conclusions of this report are preliminary and depend heavily on the interpretations of intelligence imagery, the recollections of Coalition participants, and the statements of Iraqi defectors and prisoners of war. However, the quantum improvement in intelligence-gathering means since World War II and such Iraqi sources as were available (prisoner of war debriefs and the like) provided enough information for the Survey to arrive at some conclusions that even site surveys of bombed facilities could probably not affect.

The Survey attempted to assess both direct and indirect or second-order effects, in the belief that the latter were as important as the former. An example of a direct effect would be the destruction of a hardened aircraft shelter with a 2,000-pound laser-guided bomb that penetrated the structure and detonated inside. An example of an indirect effect would be the Iraqis' subsequent efforts to preserve a portion of their air force in the face of shelter "busting" by dispersing some aircraft in the open and sending others to sanctuary in Iran. Indirect effects can also have more distant second-order consequences. The use of laser-guided bombs to "plink" Iraqi armor in the Kuwait theater not only destroyed equipment (the direct effect) but also quickly persuaded Iraqi tank crews to spend less and less time with their vehicles (the indirect effect). By the time the ground war began, the indirect effect appears to have left many Iraqi armor units unable to respond effectively to engagement by Coalition ground forces (the second-order consequence). Naturally, the methodological problems involved in assessing such intangible, but very real, indirect and second-order effects are substantial.

Control of the Air

To wage the air campaign in the Gulf, the Coalition had to control the air space over Iraq. When war came, Coalition air forces soon bottled up the Iraqi Air Force on its airfields and largely prevented effective employment of Iraq's integrated air defense system and radar-guided surface-to-air missiles (SAMs). Save for low-altitude antiaircraft artillery (AAA) and infrared SAMs in highly defended areas like Baghdad and the portions of the Kuwait theater occupied by Republican Guard divisions, the Coalition air forces quickly gained relatively unimpeded freedom of action. Air superiority—the ability of one side's aircraft to operate in

selected airspace at a given time without prohibitive interference from the other side—was achieved by the end of 17 January 1991; by 27 January 1991, Gen. H. Norman Schwarzkopf, Commander, Central Command, could declare air supremacy, meaning that the Iraqi Air Force no longer existed as a combat-effective force.³

To a considerable extent, the Iraqis conceded control of the air to the Coalition even before the war began. The Iraqi Air Force on 17 January 1991 apparently intended to ride out the initial Coalition bombing raids inside supposedly bombproof shelters while attempting some defensive counterair action under close control from Iraq's integrated air defense system.⁴ The Iraqis may have hoped to disrupt the Coalition air campaign somewhat, inflicting occasional losses on Coalition air forces by attacking stragglers and egressing strike aircraft low on fuel. This limited use of its air force mirrored Iraq's policy in the Iran-Iraq War, when neither side attempted to establish real air superiority. The Iraqi leadership believed that the army, not the air force, determined victory in modern war and that an air force had value primarily as a "force-in-being"—a protected deterrent against regional rivals.⁵

In the weeks preceding Desert Storm, Saddam Hussein confidently predicted that after the initial air strikes, the Iraqi army would still be "safe and sound and ready for battle" when Coalition ground forces appeared.⁶ As in the Iran-Iraq War, ground-based air defenses, rather than Iraqi fighters, would be relied upon to blunt any Coalition air strikes that might occur.⁷ In such circumstances, Coalition air-control operations were less a contest between opposing air forces than a concerted effort

³U.S. Department of Defense, *Conduct of the Persian Gulf War, Final Report to Congress*, Apr 1992, pp 124, 127, 129.

⁴Norman Cigar, "Iraq's Strategic Mindset and the Gulf War: Blueprint for Defeat," *The Journal of Strategic Studies*, Mar 1992, p 19.

⁵Ronald E. Berquist, *The Role of Airpower in the Iran-Iraq War* (Maxwell AFB, AL: Air University Press, 1988), pp 51, 55, 74. In November of 1980, Saddam Hussein stressed in a speech to the Iraqi National Assembly his opinion on the proper utilization of his air force: "We will not use our air force. We will keep it. Two years hence our air force will still be in a position to pound Bani-Sadr and his collaborators." (*Ibid.*, p 46.)

⁶Saddam Hussein, speech to the People's International conference, 11 Jan 1991, *Sawt-Al-Sha'b* (Amman), 12 Jan 1991, p 15, cited in Cigar, "Iraq's Strategic Mindset," p 18.

⁷Cigar, "Iraq's Strategic Mindset," p 19.

by the Coalition to minimize its losses while destroying the Iraqi Air Force on the ground, thereby denying Iraqi's goal of holding its Air Force in reserve either for a last stand or for postwar use.

Freedom of Action

The opening hours of the war saw Coalition air forces bomb key command and control elements of Iraq's strategic air defense system such as sector and intercept operations centers. Coalition fighters mounted offensive fighter sweeps over the main Iraqi fighter bases with the intent of shooting down any Iraqi fighters that became airborne. British Tornados attacked takeoff surfaces at key airfields with JP233 (an airfield-attack system containing specialized cratering and mining submunition) in order to limit the numbers of launched Iraqi fighters to quantities the Coalition fighters could readily handle. And sophisticated attacks involving drones and HARMs (high-speed antiradiation missiles) were launched against Baghdad and other areas where Iraq's radar-guided surface-to-air missiles were concentrated. These efforts were designed to bottle up the Iraqi Air Force on the ground and eliminate the threat of radar-guided SAMs at medium and higher altitudes, thereby permitting Coalition aircraft to operate there with little risk of significant attrition.

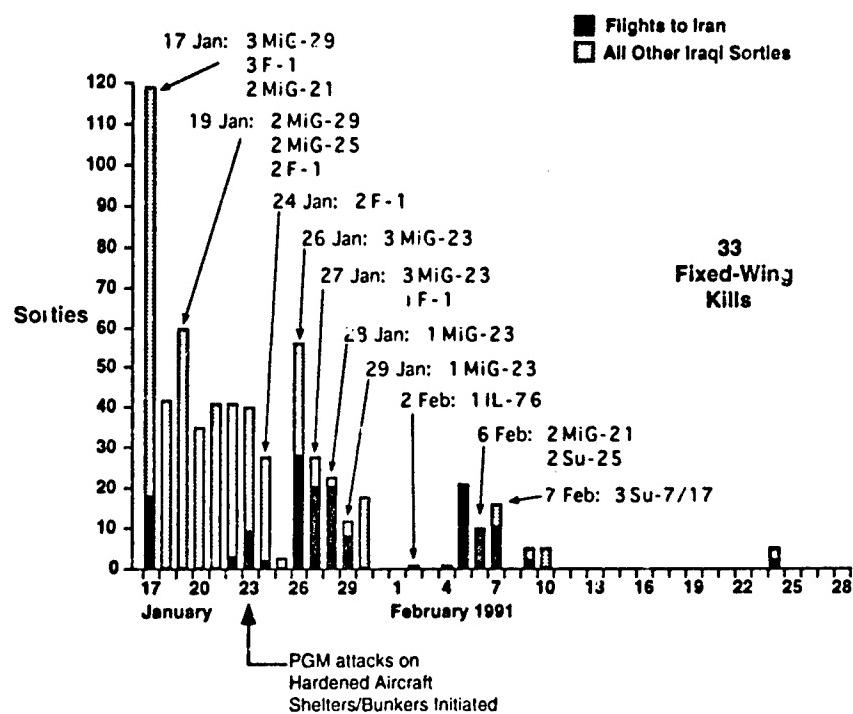
The air-to-air portion of this effort, which averaged some 340 sorties daily over the course of Desert Storm, quickly persuaded the Iraqi Air Force to stand down. By the 9th day of the war (25 January 1991), Coalition fighters had downed 16 Iraqi MiG-29s, MiG-25s, and F-1s, and Iraqi flight activity had largely ceased. By the end of Desert Storm, Coalition air forces had shot down 33 Iraqi fixed-wing aircraft (5 MiG-29s, 8 Mirage F-1s, 2 MiG-25s, 8 MiG-23s, 2 Su-25s, 4 MiG-21s, 3 Su-7/17s,⁸ and 1 IL-76) and 5 helicopters⁹ while suffering, at most, 1 air-to-air loss on the opening night of the war.¹⁰

⁸Although these three kills were officially credited as Su-7/17s, they were more likely Su-20 or Su-22 variants (Deur, *Wall of Eagles: Aerial Engagements and Victories in Operation Desert Storm*, p 41).

⁹*Conduct of the Persian Gulf War*, p 160; Deur, *Wall of Eagles*, pp 40-41). Deur's summary also includes the Mi-24 destroyed in the air by a GBU-10 laser-guided bomb from an F-15E on 14 Feb 1991, for which no "kill credit" was awarded (*ibid.*, pp 14 and 41; and "Tim Bennett's War," *Air Force Magazine*, Jan 1993, p 38).

¹⁰Intvw, GWAPS with Cmdr Mark Fitzgerald, 15 May 1992. It was thought, immediately after the war, that no Coalition aircraft had been shot down by Iraqi aircraft. Postwar reexamination of Coalition losses eventually suggested, however, that the lone

Figure 10
Iraqi Flight Activity versus Coalition Kills



Although the thirty-three to one box score provides some insight into the degree to which Coalition forces dominated in air-to-air combat, it is by no means the entire story. More than forty percent of the Coalition's kills from 17 January through 28 February 1991 involved beyond-visual-

aircraft lost on the first night of the air campaign, an F/A-18 from the *USS Saratoga*, may have been downed by an Iraqi MiG-25. Detailed reconstruction of the circumstances surrounding the fate of this aircraft produced no positive evidence that it had been lost to an Iraqi radar-guided surface-to-air missile (as was initially believed), and the known presence of an Iraqi MiG-25 in the immediate vicinity when the F/A-18 went down left the Iraqi interceptor as the most likely cause of the loss.

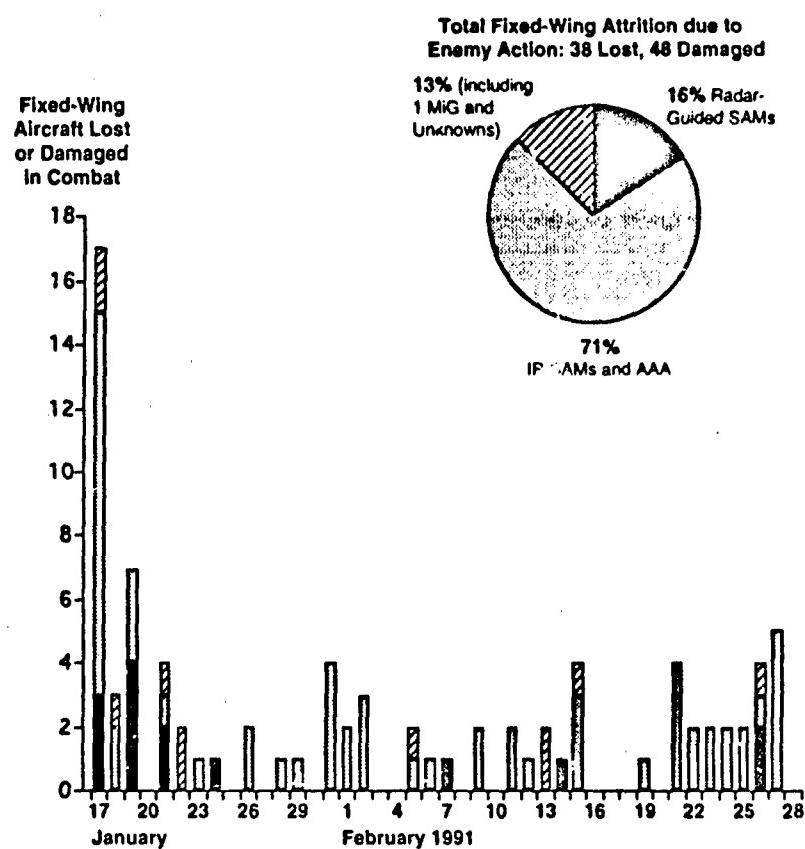
range (BVR) shots.¹¹ The Gulf War was the first conflict in history in which a large percentage of the air-to-air engagements that produced confirmed kills—sixteen of the thirty-three victories against fixed-wing Iraqi aircraft credited to Coalition fighters during Desert Storm—involved BVR shots. These BVR shots were possible because Coalition fighters, operating in conjunction with platforms such as the E-3 AWACS (Airborne Warning and Control System), could shoot BVR with little risk of accidentally hitting friendly aircraft.

Coalition planning against Iraq's ground-based air defenses had two objectives. The first was to destroy the French-built KARI command and control system—the nervous system of Iraq's air defenses—by directly attacking the system's sector and interceptor operations centers (SOCs and IOCs) and the numerous reporting and listening posts that provided early-warning information. Second, planners intended to suppress Iraq's radar-guided SAMs with drones and large numbers of antiradiation missiles from "Wild Weasel" F-4Gs, F/A-18s, and other aircraft. This Coalition endeavor produced some of the most complex attacks of the air campaign.

The most conclusive evidence of Coalition success in rendering KARI and its associated "strategic" SAMs impotent can be seen in Coalition attrition data (Figure 11). From an operational standpoint, the relevant measure of effectiveness against Iraq's ground-based air-defense system was not SOCs, IOCs, or missile-firing batteries physically destroyed but the numbers of Coalition aircraft that were *not* shot down or damaged while carrying out their missions over Iraq and the Kuwait theater of operations. During the first 6 days of Desert Storm, radar SAMs downed or damaged 8 Coalition fixed-wing aircraft; for the rest of the campaign, this segment of Iraq's air defenses only damaged or downed another 5 Coalition airplanes. Given the large numbers of combat sorties flown daily by Coalition air forces—on average, over 1,600 "shooter" sorties daily plus another 540 combat-support sorties—the relatively light losses suffered by Coalition air forces strongly support the conclusion that this portion of the air campaign was highly effective.

¹¹GWAPS Statistical Compendium, Table 206, "Coalition Air-to-Air Kills Matrix"; (S) Christie, Comfort, and Guild, *Desert Shield/Desert Storm Air-to-Air Performance Study*, pp 30-31; also Deur, *Wall of Eagles: Aerial Engagements and Victories in Operation Desert Storm*, pp 5, 8, 11, 14-15, 18-20, 25-26, 28, 31, and 33. In most cases, the rules-of-engagement (ROE) for F-15 BVR shots were satisfied by E-3A Airborne Warning and Control System (AWACS) aircraft, which were able to confirm "hostile target, no friendlies" (Christie, Comfon, and Guild, p C-5).

Figure 11
Coalition Fixed-Wing Combat Attrition By Cause



Source: GWAPS Statistical Compendium.

The role *not* played in this war by the large numbers of antiaircraft artillery pieces and infrared SAMs deployed around most Iraqi cities and targets and integral to Iraqi ground forces reinforces this conclusion. Such weapons had accounted for the vast majority (85 percent) of U.S. Air Force aircraft losses during the Vietnam war, including the 637

aircraft lost over North Vietnam.¹² The Iraqis probably hoped that their ground-based air defenses could be at least as successful as North Vietnam's had been. By the time Desert Storm ended, however, the Coalition's loss rate was only about 1 fixed-wing aircraft per 1,800 combat sorties. This loss rate was 4.7 times lower than that experienced by the United States over North Vietnam from January-December 1967 and some 14 times lower than that American air forces sustained during Linebacker II.¹³ Low losses stemmed from the combination of successful suppression of Iraqi air defense and the decision to bomb from medium altitudes. How were losses kept so low in Desert Storm? Although some crews initially tried NATO-style low-level ingress tactics during the first few nights of Desert Storm, the sheer volume and ubiquity of barrage antiaircraft artillery, combined with the ability of Stinger-class infrared SAMs to be effective up to 12,000-15,000 feet, quickly persuaded most everyone on the Coalition side to abandon low altitude, especially for weapon release. Coincident with aircrew reactions to the dangers of low-altitude operations, Brig. Gen. Buster C. Glosson quickly directed the air force units under his command to shift to medium altitude for ingress, egress, and weapons release.¹⁴

This decision had a price. For aircraft such as the F-16 and F/A-18, which principally employed unguided (or "dumb") munitions during Desert Storm, it entailed a definite sacrifice in bombing accuracy. Lt. Gen. Charles A. Horner, the Joint Force Air Component Commander, stressed in early February 1991 that American support at home for the war depended in large measure on the ability to operate "with less than anticipated" losses of human lives among Coalition airmen, soldiers, sailors, and marines.¹⁵ Coalition planners thought it imperative not to lose any more aircraft than absolutely necessary.

¹²Directorate of Management Analysis, *USAF Management Summary: Southeast Asia Review*, as of 30 Jun 1973, pp 28 and 30.

¹³DOD, OASD/Comptroller, Directorate of Information Operations, Table 311 (22 Jun 1972) and Table 321 (19 Apr 1972); and (S) Headquarters Pacific Air Forces (PACAF), Directorate of Operations Analysis, *Summary: Air Operations Southeast Asia*, Jan 1973, pp 4-B-1 and 4-B-2.

¹⁴Intvw, Maj Gen Buster C. Glosson with GWAPS personnel, 14 Apr 1992. As would be expected, the exact flight and weapon-release "floors" for many aircraft fluctuated during the course of the war in response to tactical conditions and mission requirements.

¹⁵"Daily Comments of Lt Gen Charles A. Horner, Commander USCENTAF, during Operation Desert Storm, 17 Jan - 28 Feb 1991," entry for 7 Feb 1991/1700, GWAPS, CHC.

The final component of the Coalition's efforts to gain and maintain air superiority consisted of attacks on Iraqi airfields. Over the first five days, strikes against runway surfaces—particularly those strikes by Royal Air Force (RAF) Tornados delivering from low altitude the runway-cratering bomblets and area-denial mines carried by the JP233 system—were used to limit Iraqi flight activity. Toward the end of the first week of Desert Storm, the Coalition effort against Iraq's main operating bases shifted from runway surfaces to hardened aircraft bunkers and shelters. By then it was clear that Coalition fighters could shoot down virtually any air-to-air opposition that the Iraqis might choose to put into the air. At the same time, Iraqi flight activity had trailed off, which meant that the value of attacks on takeoff surfaces was also declining. As air planners in both Riyadh and Washington quickly realized, it made little sense to mount JP233 sorties against runways that the Iraqis were not using.¹⁶

The campaign to attack hardened aircraft shelters on Iraqi airfields with precision-guided munitions began on the night of 22/23 January 1991 with attacks by F-111Fs delivering laser-guided bombs on about half of the hardened aircraft shelters at Al Asad airbase.¹⁷ The Iraqis then began flying combat aircraft to sanctuary in Iran.¹⁸

Because only two Coalition aircraft, the F-117 and F-111F, carried hard-target penetrators (the GBU-27 and the GBU-24A/B with the I-2000 or BLU-109 warhead), and because Iraq had a large number of hardened shelters (nearly 600) scattered throughout the country, the effort against aircraft shelters would become a relatively slow campaign of incremental attrition. Inevitably, this approach gave the Iraqis an opportunity to play shell games both on and off the airfields with their surviving combat aircraft. By dispersing aircraft into the open on the airfields, they could preclude Coalition aircraft from getting both a shelter and a combat aircraft with a single laser-guided bomb. By moving aircraft in the open regularly—every day or so—they could make it difficult for Coalition plan-

¹⁶There was much speculation during and after the war that the four GR-1 Tornados the RAF lost before the last JP233 attacks on 21 Jan 1991 could be attributed to the low-level ingress and delivery tactics demanded by the JP233 system. But, in fact, two of these losses were due to radar SAMs, and only one of the four occurred on a JP233 sortie (Alfred Price, "Tornado in the Desert," *Air Force Magazine*, Dec 1992, p 44).

¹⁷GWAPS Missions Database, entries for the 48th TFW, mission numbers 2601A, 2602A, 2606A, 2607A, 2611A, 2613A, 2614A, 2623A, and 2627A on ATO Day 6.

¹⁸(S) "Fac: Paper: IZAF Aircraft to Iran," 11 Feb 1991, GWAPS, CHC-10, p 1.

ners to target individual aircraft. By dispersing aircraft off the airfields, they could increase the area to be searched. And, last but not least, the Iraqis exploited the Coalition's reluctance to risk damage to cultural monuments such as Islamic mosques by parking combat aircraft near them.

In the end, the Coalition destroyed some 375 hardened aircraft shelters across a total of 44 major airfields, including three in Kuwait.¹⁹ As for the Iraqi Air Force, it lost as many as 400 of the more than 700 combat aircraft it had possessed on 17 January 1991, either through destruction or as a result of being retained by Iran. By war's end, the Iraqis still possessed an estimated 300-375 combat aircraft, and the level of destruction of the Iraqi Air Force was not as complete as the air planners and commanders in Riyadh would have preferred. The Coalition's emphasis on aircraft shelters did permit some Iraqi aircraft to survive the war out in the open, while the short flight times (10-15 minutes) to Iranian airspace from fields in central Iraq made it nearly impossible for Coalition aircraft to seal off the Iranian border to fleeing Iraqi aircraft.

Strategic Attacks

In the minds of the Desert Storm air planners, the "strategic core" of the air campaign consisted of the following eight out of twelve target categories: (1) command, control, and communications; (2) leadership facilities; (3) nuclear, chemical, and biological warfare capabilities and weapons programs; (4) military support facilities (e.g., ammunition storage, logistics and repair sites); (5) ballistic missiles launchers and their supporting infrastructure; (6) electric power; (7) oil refineries; and (8) key bridges and railway facilities. The Black Hole's target list for these eight categories contained 295 targets on 15 January 1991 and 535 on 26 February 1991, a growth that reflects a continuing influx of intelligence throughout the 43-day war.

Using strikes—meaning occasions on which individual aircraft released ordnance against distinct targets or aimpoints—the eight "strategic" target categories absorbed about fifteen percent of the Coalition's air-to-ground efforts during Desert Storm.²⁰ By comparison, attacks against Iraqi sur-

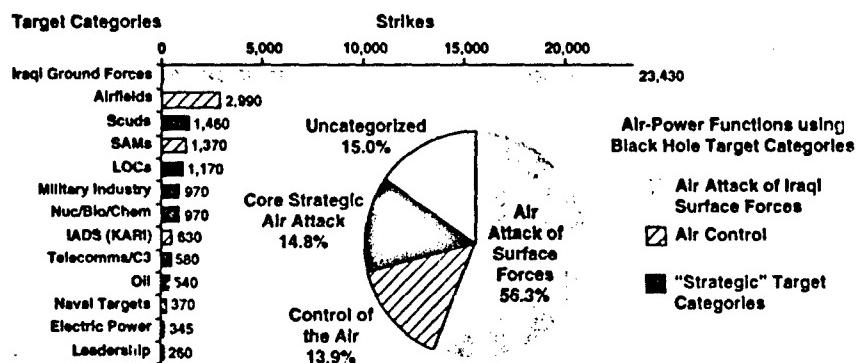
¹⁹(S/WN/REL UK, CA, AS) DIA/DX-53, "Battle Damage Assessment: Iraqi and Kuwaiti Airfields, Summary Report," 10 May 1991.

²⁰The traditional input measure for level of effort by air forces has been sorties. However, early research revealed that aircraft like the F-117 and F-111F often used precision-guided bombs to hit two or more targets on a single sortie. Strike counts were

face forces absorbed at least fifty-six percent of the strikes, and efforts aimed at air control, another fourteen percent.²¹

The percentage of strikes against the eight strategic target categories shown in Figure 12 may appear relatively small, given the degree of attention devoted to this aspect of the air war by planners and, subsequently, by the public. This attention reflected the importance that a number of the air planners ascribed to attacking the core of Iraqi power and the hopes that some harbored for bringing down the Iraqi regime through the use of air power alone.

Figure 12
Coalition Strikes by Target Categories and Air-Power Function
(17 Jan-28 Feb 1991)



Source: GWAPS Missions Database, Dec 1992. All strike totals have been rounded off to the nearest multiple of ten (e.g., 284 was rounded off to 280, and 539 to 540). Strike totals include a number still uncategorized. Most of these uncategorized strikes were A-10, F/A-18, or AV-8 sorties that, in all likelihood, were targeted against Iraqi ground forces. Strike totals do not include maritime strikes carried out by U.S. Navy aircraft as part of fleet defense operations.

An estimated thirty percent of the precision-guided bombs delivered during Desert Storm were targeted against the eight core strategic-target categories, roughly double the percentage of the total strikes they re-

vised to capture this aspect of Coalition air power in the Gulf War.

²¹These percentages total well short of 100% due to the portion of reported strikes that GWAPS was unable to categorize by target category due to incomplete data. The majority of these strikes, though, almost certainly went against Iraqi ground forces. Note too that the more than 340 air-to-air sorties a day that the Coalition averaged during Desert Storm are over and above the roughly 42,000 strikes in the GWAPS Missions Database.

ceived.²² So these target categories absorbed a disproportionate share of the precision strikes.

The purposes for which the eight core target categories were chosen suggest some natural groupings. These groupings, which will be the subjects of the next three sections, are:

- **Leadership and Telecommunications/Command, Control, and Communications (L & CCC),²³**
- **Electricity and Oil (E & O), and,**
- **Nuclear/Biological/Chemical and Scuds (C & SC).**

Two core strategic categories are ignored by these groupings; namely, railroads and bridges (RR) and military research, production, and support (MS). Bridges and railroad facilities, although defined as a core target category, were, for the most part, attacked to affect the supply and support of forces in the Kuwait theater; therefore, effects against this target category fall in the discussion of air interdiction operations, treated later in this chapter. Second, the parts of both the MS and RR categories not associated with interdiction mostly fall under the other six core target categories. Examples would include Scud-related targets in MS and bridges in RR that were located in downtown Baghdad or thought to conceal fiber-optic cables linking the Iraqi leadership to Scud units.

Leadership and Telecommunications/C³

By attacking the two "leadership" target categories—L and CCC, Black Hole's category designators—campaign planners hoped to disrupt the "central nervous system" of Saddam Hussein's Ba'athist regime. They

²²GWAPS Missions Database, 2 Mar 1993. Precision-guided munitions counts proved such a problem in the case of certain aircraft that in late 1992 it was decided to exclude them from the statistics report. The 30% figure for the portion of the precision-guided bombs that were directed against the eight core strategic target categories ignores antiradiation missiles like HARM as well as Mavericks delivered by A-10s.

²³Target-category designators such as "L" for leadership and "E" for electricity were introduced by Lt Col David Deptula to ease the daily task of reviewing each day's master attack plan. These "Black Hole" categories were never entirely reconciled with those in DIA's Automated Installations Intelligence File (AIF) by GWAPS researchers through the end of 1992.

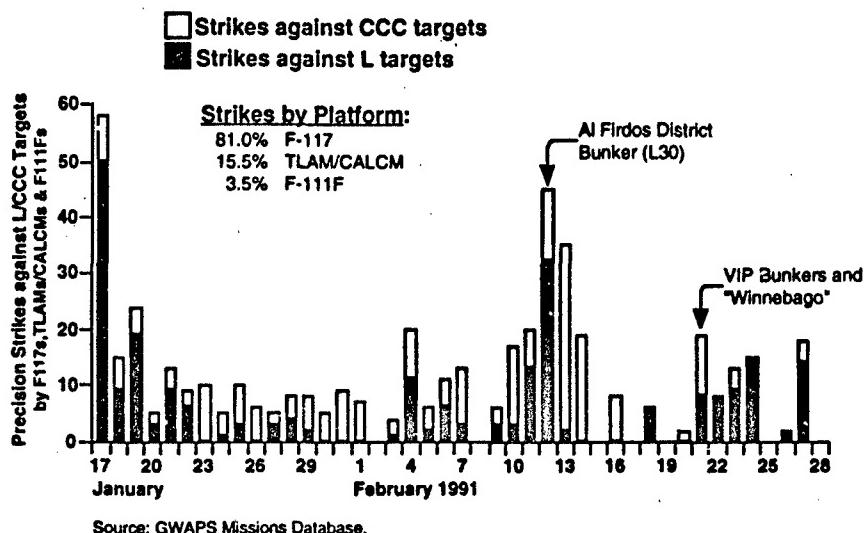
targeted the various governmental facilities—official residences, government ministries, and command and control bunkers—used by Saddam and his close associates to rule the country, maintain control over the people, and direct military operations (the L targets). The various means by which the Ba'athist leaders communicated with one another, the Iraqi people, the Iraqi military, and the outside world—redundant coaxial and fiber-optic land lines for voice and data, TV and radio stations,²⁴ microwave radio relays, associated switching facilities (many of them computerized), and satellite communications stations—were identified as a second “leadership” target category (the CCC targets). Attacking these targets would directly threaten those most responsible for the occupation and pillaging of Kuwait. At the same time, Coalition air planners reasoned that if they could erode the ability of Saddam Hussein and his close associates to exercise tight control of Iraq's military forces, the Iraqi regime would not be able to react effectively to Coalition initiatives or to conduct coordinated military operations.

The strikes that inflicted the bulk of the physical damage to the L and CCC target categories involved precision munitions, carried out principally by F-117s. Given the hardness, small size, and location in urban areas of many of the targets involved, primary reliance on the F-117/GBU-27 combination made considerable sense, both for certainty of destruction and limitation of collateral damage. Fiber-optic relay stations offer a case in point; only a precision-guided weapon or a lucky hit against the below-ground junction box really effected a cut in the fiber-optic line. Even if strikes against these relay stations with unguided bombs succeeded in completely destroying the above-ground structures, the fiber-optic line often remained intact unless cut with precision munitions.

The peak levels of precision strikes against Iraqi leadership and its means of communication occurred on the first two nights, and relatively significant numbers of strikes continued for much of the first week. Over the second and third weeks, L targets received less emphasis. CCC, by contrast, got a smaller but fairly steady number of precision sorties over the first three weeks. The level of precision effort against CCC picked up during the fourth week, only to be followed by a more sporadic pattern for the rest of the conflict.

²⁴Radio stations could not only be used to rally the Iraqi populace but were correctly assessed by Coalition intelligence to be a conduit for triggering Iraqi agents abroad to initiate terrorist attacks.

Figure 13
Precision Strikes against Leadership
and Telecommunications/C³



The climax of effort against these leadership targets came toward the end of Desert Storm's fourth week; Master Attack Plans for 9 through 13 February reflected renewed interest in this target category by those in the Black Hole. However, the F-117 strikes against the Al Firdos district bunker in downtown Baghdad, which were carried out in the early morning hours (Riyadh time) of 13 February 1991, precipitated a tightening of higher-level control over strikes on Baghdad in general and on leadership targets in particular.²⁵ The Al Firdos bunker was one of ten leadership bunkers located in the suburban areas of Baghdad. None of them was hit during the opening weeks of the war because intelligence believed that

²⁵Harold P. Myers and Vincent C. Breslin, *Nighthawks over Iraq: Chronology of F-117A Stealth Fighter Operations, Desert Shield and Desert Storm* (Office of History, 37th Fighter Wing), p 26.

the Iraqis were not using them.²⁶ Not until the first week in February 1991 did intelligence sources indicate that the Al Firdos bunker had been activated.²⁷ Subsequently, various delays, including weather, prevented an attack until the early hours of 13 February.²⁸ Unknown to Coalition air planners, the upper level of the bunker was, according to the Iraqis, being used at night by families. Hits on the facility by two GBU-27s, both aimed at the same point on the bunker's roof by two different F-117s, were reported that morning by CNN (Cable News Network) as having caused hundreds of civilian casualties.²⁹ Iraqi sources claimed that 200-300 civilians, including over 100 children, died in the bunker³⁰ and quickly exploited the tragedy. In the wake of dramatic television coverage, a sharp reduction in Coalition air strikes against L targets ensued. Among other changes, General Schwarzkopf thereafter personally reviewed any targets selected for air attack in downtown Baghdad.³¹ Consequently, air planners in Riyadh did not resume their efforts until the sixth and final week of the war to "finish off" the L targets.

By the end of the second week of the war, Coalition air planners and intelligence analysts became increasingly convinced that Iraq's national-

²⁶As late as 31 Jan 1991, Checkmate analysts characterized the ten bunkers as "secondary leadership targets" [(S) "Additional Leadership Targets List," Msg from Checkmate to the Black Hole, 311730Z Jan 1991; BH, Box 2, Folder 24, Intel/Tgt Info #1].

²⁷(S/WN) DIA, *Desert Storm Intelligence Bulletin*, "Possible C3 Bunker Activated (63-91), as of 080530Z Feb 1991, (BH, Box 2, Folder 24, Intel/Tgt Info #1). The judgment that the bunker had been activated appears to have been based on the fusion of separate pieces of intelligence.

²⁸Intvw, GWAPS with Lt Col David Deptula, 20 and 21 Dec 1991.

²⁹Msg from Checkmate to the Black Hole, "Additional Leadership Targets List," 311730Z Jan 1991 (BH, Box 2, Folder 24, Intel/Tgt Info #1, p 3); GWAPS Missions Database for ATO Day 27. The records on L targets... : Intelligence/Target Information folders used by Lt Col Deptula during the war, as well as comments recorded at the time in the Tactical Air Control Center and Gen Horner's daily briefings all confirm this account of how and why the Al Firdos district bunker came to be struck. It was a legitimate military target, and Coalition planners had no indications before seeing post-strike television coverage over CNN that it had been occupied by civilians.

³⁰Middle East Watch, *Needless Deaths in the Gulf War* (Washington, DC: Middle East Watch, 1991), pp 128-129.

³¹Lt Col David Deptula, GWAPS Intvw, 20 & 21 Dec 1991. Deptula's personal notes from the war confirm that on 13 Feb 1991 Gen Glosson was instructed by Gen Schwarzkopf to begin showing him all targets selected for attack in downtown Baghdad before they were struck.

level telecommunications system had not collapsed as a result of attacks on central switching and microwave relays, despite the lethality and precision of the attacks.³² The system turned out to be more redundant and more able to reconstitute itself than first thought. Fiber-optic networks and computerized switching systems proved particularly tough to put out of action.

How effective were the Coalition attacks on Iraqi leadership and Telecommunications/Command, Control, and Communications (C3)? Using the Black Hole's target categories, a total of some 260 precision and nonprecision strikes were carried out against the L targets by the war's end; another 580 precision and nonprecision strikes were mounted against the CCC category. Yet, at the war's end, Saddam Hussein was still alive and his Ba'athist regime still in power. Moreover, the Iraqi government had been able to continue launching Scuds during the final days of the campaign.³³ Although the capacity of the communications links between Baghdad and its field army in the Kuwait theater of operations had been greatly reduced, sufficient "connectivity" persisted for Baghdad to order a withdrawal from the theater that included some redeployments aimed at screening the retreat. Thus, the results of these attacks clearly fell short of fulfilling the ambitious hope, entertained by at least some airmen, that bombing the L and CCC target categories might put enough pressure on the regime to bring about its overthrow and completely sever communications between the leaders in Baghdad and their military forces.

Coalition attacks on the L and CCC targets categories need not, however, be judged against this ambitious goal. In retrospect, it may be fairer to ask how *much* disruption and dislocation these attacks imposed on the functioning of the Iraqi government and its telecommunications. Common sense would argue that strikes against these two target categories must have imposed *some*, if not *considerable*, disruption and dislocation on the Iraqis involved. F-117s carried out the bulk of the 480-plus precision strikes against L and CCC targets. Hits from 2,000-pound bombs within feet of the desired aimpoints on government ministries, national command and control facilities, headquarters, and telecommuni-

³²(S) Lt Gen Thomas W. Kelly, Director of Operations, JCS, Memo to USCENTCOM/J-3, "Iraqi Backbone Telecommunications Vulnerabilities"; also, handwritten note from Checkmate to the Black Hole, 28 Jan 1991 (GWAPS, BH, Box 2, Folder 24, Intel/Tgt Info #1).

³³The last Scud launches occurred on 26 Feb 1991.

cations centers forced many elements of Saddam Hussein's government to relocate (in some cases several times) and to shift to backup communications. Such strikes disrupted normal telephone communications and undoubtedly caused a number of government officials to fear for their lives. Even Saddam Hussein's control of the Iraqi people seems to have been shaken; immediately after the war, rebellions against Saddam Hussein's rule occurred among the Kurds in the north and Shiite Muslims in the south. Western reporters observed that, for the first time in years, ordinary Iraqi citizens were willing to criticize Saddam Hussein openly.³⁴ Yet, the question remains: Given these generalized effects and related symptoms, did the bombing of L and CCC targets come within a hair of shattering Saddam Hussein's Ba'athist regime, or did it fall well short? On the evidence available to the Survey, no firm answer can be given. Without access to high-level Iraqi officials and records, the *degree* of disruption and dislocation inflicted by strikes in the L and CCC target categories cannot be quantified, not even roughly. While there were signs that the Iraqi regime was shaken and its telecommunications disrupted, the hoped-for collapse did not occur, and judging how close the Coalition came does not appear possible on the available evidence.

Electricity and Oil

Planners wished to minimize long-term damage to Iraq's economic infrastructure, even as they provided for attacks against both electricity and oil targets. This constraint led air planners and targeting specialists to try to restrict attacks on Iraqi electric power to strikes on transformer/switching yards and control buildings rather than on generator halls, boilers, and turbines in order to minimize recuperation time after the conflict ended.³⁵ Similarly, attacks on oil production were supposed to concentrate on refined-product storage; distillation and other refining areas were to be aimpoints only if they produced military fuels.³⁶

However, in the case of electric power, pilots did not generally refrain from hitting generator halls or their contents especially during the

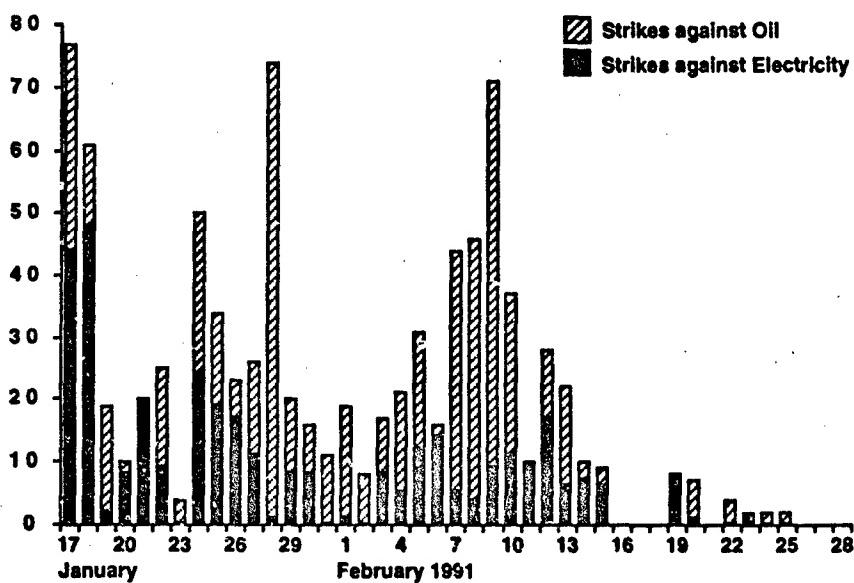
³⁴Chris Hedges, "After the War: Iraq in Growing Disarray, Iraqis Fight Iraqis," *The New York Times*, 10 Mar 1991, pp. 1, 14.

³⁵Memo, Brig Gen Buster C. Glosson, "Target Guidance."

³⁶Memo, Gen Glosson, "Target Guidance."

first week or so of the war.³⁷ Part of the reason was that the planners elected to go after the majority of Iraq's twenty-five major power stations and the generator halls offered the most obvious aimpoints. In addition, some of the flying units were not aware that operational planners in Riyadh were attempting to limit long-term damage. Much the same thing occurred with oil targets; in a number of instances, aircraft attacked crude-oil distillation towers despite the intended policy of minimizing long-term damage.³⁸ Both discrepancies illustrate the gap that can exist between specifying a target such as a petroleum refinery and picking the particular aimpoints to be hit there.

Figure 14
Strikes against Electricity and Oil



Source: GWAPS Missions Database.

³⁷That boilers and generator halls were damaged has been well documented by both Coalition wartime reconnaissance and postwar site inspections by members the international study team that surveyed many bombed facilities from 23 Aug to 5 Sep 1991 (Walid Doleh, Warren Piper, Abdel Qamhieh, and Kamel al Tallaq, "Electric Facilities Survey," Oct 1991, Appendix A; and (S/WN) Defense Intelligence Agency (DIA), *Desert Storm BDA Imagery Review*, DDX-2900-489-91, Vol. 3, pp 48-53).

³⁸DIA, *Desert Storm BDA Imagery Review*, Vol. 3, pp 12-13, 27-29.

The 25 major generating plants of the Iraqi electrical power system consisted of collocated transformer and switching yards and more than 140 transformer stations (not collocated) linked together on a national grid. The system had a prewar installed capacity of 9,500 megawatts.³⁹ However, it generally operated at approximately 5,000 megawatts, less than 55 percent of installed capacity, prior to the war.⁴⁰ Overall, the Iraqi electric power system was relatively modern, redundant, and flexible. It served the needs of Iraq with few of the service interruptions and brown outs typical of many other third-world countries.⁴¹ Similar excess capacity existed in the Iraqi oil industry. Before Operation Desert Storm, Iraq could refine more than 580,000 barrels of oil per day—twice the amount needed to service its own domestic and military needs.

The Coalition mounted some 890 strikes against electric power and oil. The bulk of effort against electricity came early in the campaign, with almost 60 percent of the strikes, including over 60 by Tomahawk Land Attack Missiles, occurring within the first 11 days of Desert Storm. The peak effort against oil, by comparison, came more toward the middle of the campaign.

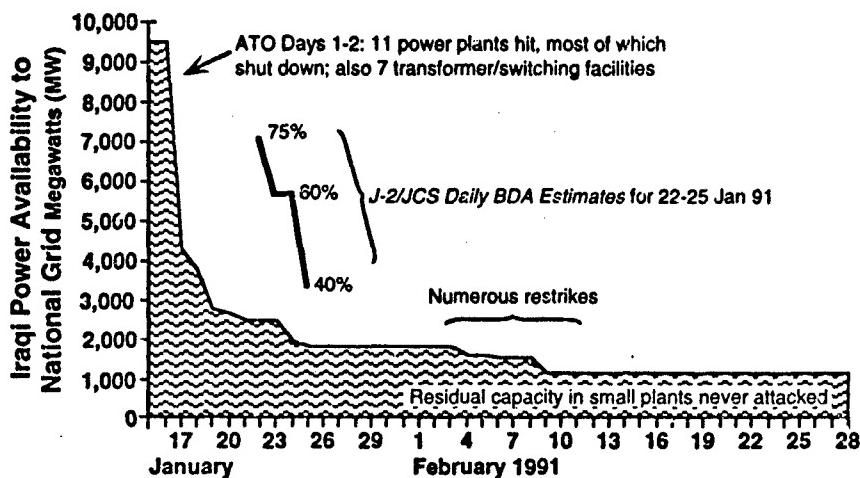
How effective were Coalition air efforts against the E and O target categories? In the case of electricity, the attacks rapidly shut down the generation and distribution of commercial electric power throughout most of Iraq, forcing the Iraqi leadership and military on to back-up power. Ultimately, almost eighty-eight percent of Iraq's installed generation capacity was sufficiently damaged or destroyed by direct attack, or else isolated from the national grid through strikes on associated transformers and switching facilities, to render it unavailable. The remaining twelve percent, mainly resident in numerous smaller plants that were not attacked, was probably only available locally because of damage inflicted on transformers and switching yards.

³⁹Walid Doleh, Warren Piper, Abdel Qamhieh, and Kamel al Tallaq, "Electrical Facilities Survey," Oct 1991, p 1 in International Study Team, *Health and Welfare in Iraq After the Gulf Crisis: An In-Depth Assessment*, Oct 1991.

⁴⁰Doleh, Piper, Qamhieh, and Tallaq, "Electrical Facilities Survey," p 1.

⁴¹Doleh, Piper, Qamhieh, and Tallaq, "Electrical Facilities Survey," Appendix A, "Reports of Sites Visited," pp 1-15.

Figure 15
Estimated Drawdown of Iraqi Electric Power



In northern Iraq, Coalition aircraft did not have precision munitions; hence, the drawdown of commercial electric power there took place more gradually than in the central and southern portions of the country. U.S. pilots flying missions from Turkey into northern Iraq occasionally reported seeing illuminated towns through the end of January 1991, and Proven Force F-111Es continued to attack northern power plants during the first week of February.⁴² Nevertheless, the electric power in *central and southern Iraq* went down during the initial days of the war, just as the planners had hoped.

How much damage did air attacks ultimately do to Iraq's electric power system? Despite the continuation of United Nations sanctions, the Iraqis restored commercial power considerably faster than had been anticipated. For example, planners initially thought that two years would be required to repair the main power plant in Baghdad. But by mid-1992, this plant was reportedly working at ninety percent of its prewar capacity, and, despite a blazing hot summer, not one power blackout occurred in Saddam Hussein's capital even though almost everyone

⁴²GWAPS Missions Database.

in Baghdad with air conditioners were running them full blast.⁴³ The speed with which the Iraqis restored capacity without external assistance provides evidence that Coalition air inflicted little long-term damage on the Iraqi power system. Even those who charged that the bombing of target systems like electric power had been "unnecessary" readily conceded, on the basis of extensive postwar site inspections, that the strategic air campaign had resulted in very few Iraqi civilian casualties.⁴⁴

Some critics argued, however, that the bombing of electric power had "contributed to" 70,000-90,000 *postwar* civilian deaths above normal mortality rates over the period April-December 1991—principally because of the lack of electricity in Iraq for water purification and sewage treatment following the cease-fire.⁴⁵ These calculations were made without anticipation of the unexpectedly rapid resumption of electric power in Iraq, however.

⁴³Marie Colvin, "Saddam Erases the Scars of War," *London Sunday Times*, 4 Oct 1992, p 16.

⁴⁴Greenpeace's estimates of countrywide Iraqi civilian casualties caused by Coalition bombing totaled 2,278 dead and 5,976 injured (William Arkin, brfg viewgraph titled, "Civilian Casualties and Damage," presentation given to GWAPS personnel, 31 Oct 1991). Arkin, for example, has stated that the air war was "clean on a strategic level," and that he could find no evidence of indiscriminate attacks on cities or civilians, intentional damage for postwar leverage on the government of Saddam Hussein or extensive collateral damage of civilian structures near targets ("Tactical Bombing of Iraqi Forces Outstripped Value of Strategic Hits, Analyst Contends," *Aviation Week & Space Technology*, 27 Jan 1992, pp 62, 63). After the war, Arkin was able to inspect "13 of the targeted leadership and command bunkers; 49 of the 170 command, control and communications sites; 16 of the 20 oil refineries and distribution facilities, and all of the 75 railroad and auto bridges" hit during the war (*ibid*, p 62).

⁴⁵"Tactical Bombing of Iraqi Forces Outstripped Value of Strategic Hits, Analyst Contends," p 63. By May 1991, the Harvard Study Team reported sharply increased levels of gastroenteritis, cholera, typhoid, and malnutrition in Iraqi children due to the delayed effects of the Gulf War (Harvard Study Team, *Harvard Study Team Report: Public Health in Iraq after the Gulf War*, May 1991, pp 12-13). One of the most vocal advocates of this view has been William M Arkin, director of the nuclear information unit of Greenpeace International. The estimate of 70,000-90,000 additional deaths was derived from a survey of some 90,000 Iraqi households conducted in 1991. Based on this data, the additional deaths above the January 1991 "norm" were calculated for April-December 1991 (Arkin, GWAPS intvw, 19 Oct 1992). The final death total due to the "indirect detrimental health effects" of the war cited by Arkin was 111,000 (Beth Osborne Daponte, "Iraqi Casualties from the Persian Gulf War and Its Aftermath," p 2).

Coalition planners believed from the outset that if Saddam Hussein's forces were decisively defeated, the Iraqi leader would not long survive the war in power. They further believed that once an accommodation had been reached with the new government in Baghdad, members of the Coalition could provide the parts and anything else necessary to restore electric power speedily throughout Iraq after the war. The political outcome turned out to be something that no one foresaw. Saddam Hussein both retained power and continued to defy the United Nations, thereby causing the continuation of economic sanctions that prevented Coalition assistance in reconstruction or humanitarian relief. To attribute responsibility for Iraq's increased mortality rate in the aftermath of a major military defeat solely, or even primarily, to the damage inflicted on Iraq's electric-power system ignores the Iraqi government's responsibility for its own prewar and postwar decisions.

Turning to Coalition efforts against Iraqi oil, strikes against refining capacity appear to have been considerably more effective than those directed against stores of refined products that could be put to military use. Iraq's refining capacity resided in the three large facilities at Baji, Basra, and Baghdad. The CIA eventually concluded that Coalition air strikes had rendered more than 90 percent of Iraq's petroleum refining capacity inoperative.⁴⁶ This judgment was based primarily on damage to distillation towers, inflicted chiefly by a very small number of precision strikes. For the most part, aircraft delivering nonprecision munitions attacked oil storage tanks with more visible but less damaging results. Given the small level of effort expended to disable over 90 percent of Iraq's refinery capacity, this aspect of the air campaign appears to have been both highly leveraged and effective.

How enduring was the damage inflicted on the Iraqi oil industry as a whole? As of October 1992, Iraqi officials claimed that crude-oil production had returned to 800,000 barrels a day and could be increased to 2 million barrels a day (about two-thirds of Iraq's prewar capacity). In addition, restored refineries were supplying more than enough gasoline and heating oil for Iraq's domestic needs and exports to Jordan. Thus, there is no evidence that the air campaign inflicted lasting infrastructure damage to Iraq's oil industry.

⁴⁶(S/WN/NF/REL UK, CA, AS) CIA, "Imagery Update: #35," 19 Mar 1991, p 1.

Finally, how close did the bombing of this target category come to achieving the goal of limiting the fuel and lubricants available to Iraqi forces for military operations? For the most part, the Iraqi Air Force chose to stay in its shelters and sit out the war, hence it required little fuel. Iraqi ground forces in the Kuwait theater had access to Kuwaiti oil facilities and continued to operate the Kuwaiti refining facilities and use Kuwaiti stocks. Eventually, Coalition air forces began bombing selected Kuwaiti oil facilities to limit use of the stocks. Even so, the amount of diesel fuel available for ground operations at the outset of what turned out to be a 100-hour ground campaign would probably have sufficed for weeks, if not months, of combat.⁴⁷ Before that time, most Iraqi forces in the theater were dug into static positions and had minimal POL (petroleum, oil, lubricants) requirements. Individual units faced local shortages because of distribution problems to which Coalition air power undoubtedly contributed by striking targets such as trucks and bridges. However, the limited difficulties caused by local shortages were not the result of Coalition attacks on Iraqi refineries and major petroleum depots.

Was the strategic effort against Iraqi oil wasted or unnecessary? Again, one must recall the uncertainties under which the air planners and commanders labored at the time. On the evening of 16 January 1991, no one knew how long the war would last or how well the fourth largest army in the world would resist Coalition efforts to liberate occupied Kuwait. If the ground campaign had become protracted, the efforts against oil might have eventually paid military dividends on the ground. There were sound military reasons for limiting the availability of refined fuels and lubricants as a hedge against the possibility that the war would not proceed as favorably for the Coalition as it did. The effectiveness of these efforts lay, therefore, mainly in limiting the Iraqis' ability to wage a protracted ground campaign. It was prudent to have done so, but attacking oil refineries and storage in Iraq bore no significant military results due to the swift collapse of the Iraqi Army.

⁴⁷(S/NF/REL MNF) Desert Storm Studies Group, U.S. Army Intelligence and Threat Analysis Center, "Status of the Iraqi Logistics Systems in the KTO," annotated Brfg. 2 Feb 1991, GWAPS, CHST 50-3 & CBDA, Folder 19; also (S/NF) Iraq Regional Task Force, "Iraq: Sustainment Capabilities for the KTO," Desert Storm Defense Special Assessment, DSA 171-91, 20 Feb 1991, p 2). It is not surprising that intelligence estimates varied considerably concerning how many Iraqi combat days might be sustained by on-hand stocks (such as diesel fuel) in the Kuwait theater. While these sorts of estimates are always asked for and made, they have inevitably been based on rather speculative methodologies.

Nuclear/Biological/Chemical Targets and "Scuds"

Coalition planners had the explicit military objective of destroying Iraq's chemical, biological, and nuclear capabilities. In the short term, that goal supported Coalition's generic military objective of destroying Iraq's capability to wage war. In the far term, destroying Iraq's nuclear program and its modified Scud ballistic missile capability would support the political objective of promoting the peace and stability of the Persian Gulf region.

The U.S. intelligence community agreed during the final months of 1990 that Iraq had extensive nuclear, chemical, and biological warfare capabilities housed in a number of facilities, but the true extent of these programs was unknown. By 1990, Iraq was estimated to be producing as much as 1,000 tons of chemical agents annually, including mustard-type blister agents and the nerve agents sarin and tabun, at the Samarra and Habbaniya facilities.⁴⁸ Iraq had also used chemical agents against Iranian forces during the Iran-Iraq War. So there was little doubt about the existence of Iraqi chemical-warfare capabilities. What proved harder to predict with certainty was whether, and under what circumstances, Iraq would employ its chemical weapons against the Coalition.

Iraq's biological weapons program dated from the late 1970s, but pre-Desert-Storm estimates as to its exact nature and status were much less certain than those on chemical weapons. The United States believed that Iraq had developed anthrax spores and botulinum toxin as agents, and that Iraqis were pursuing other toxins and live agents. Enough research, production, and storage facilities suspected of being involved with biological weapons had been identified at various locations (Salman Pak, Taji, and two facilities at Abu Ghurayb) to suggest that the Iraqis had produced such agents in militarily significant quantities.⁴⁹

The Iraqi nuclear program was massive,⁵⁰ for most practical purposes fiscally unconstrained, closer to fielding a nuclear weapon, and less

⁴⁸(S/WN) Michael J. Eisenstadt, "*The Sword of the Arabs: Iraq's Strategic Weapons*, Washington Institute for Near East Policy, Policy Paper Number 21, 1990, p 5; Defense Intelligence Agency, "Special Analysis: Degradation of the Iraqi Chemical Warfare Capability," DDB-1620-28-91, 20 Feb 1991.

⁴⁹Eisenstadt, pp 7-8.

⁵⁰After the war, it was determined that the Iraqi nuclear program had employed over 20,000 people (David Kay, "Arms Inspections in Iraq. Lessons for Arms Control," p 2, GWAPS, NA 375).

vulnerable to destruction by precision bombing than Coalition air commanders and planners or U.S. intelligence specialists realized before Desert Storm. The target list on 16 January 1991 contained two nuclear targets, but after the war, inspectors operating under the United Nations Special Commission eventually uncovered more than twenty sites involved in the Iraqi nuclear weapon program; sixteen of the sites were described as "main facilities."⁵¹

Militarily, there were at least two critical areas of uncertainty concerning Iraq's ballistic missile capabilities in the months preceding Desert Storm. One concerned the number of mobile launchers and operational missiles the Iraqis possessed. The other had to do with how the Iraqis might choose to employ these weapons against Coalition forces.

When Desert Storm began, Coalition planners appear to have assumed that the Iraqis would launch their ballistic missiles initially from fixed or known launch sites, giving Coalition air power a reasonable chance of eliminating the Scud threat—or most of it—in the opening hours of the war.⁵² If the Iraqis did shift to mobile operations under attack, Coalition planners assumed that their set-up and launch procedures would resemble those utilized by Soviet Scud units in central Europe. More specifically, the mobile launchers would not only require several hours to launch a missile but, in the process, provide distinctive signatures that Coalition forces could exploit to locate and attack them. Planners also assumed that decoys or other "background noise" would not greatly complicate the problem of dealing with Iraqi Scud units. None of these assumptions proved accurate during the war.

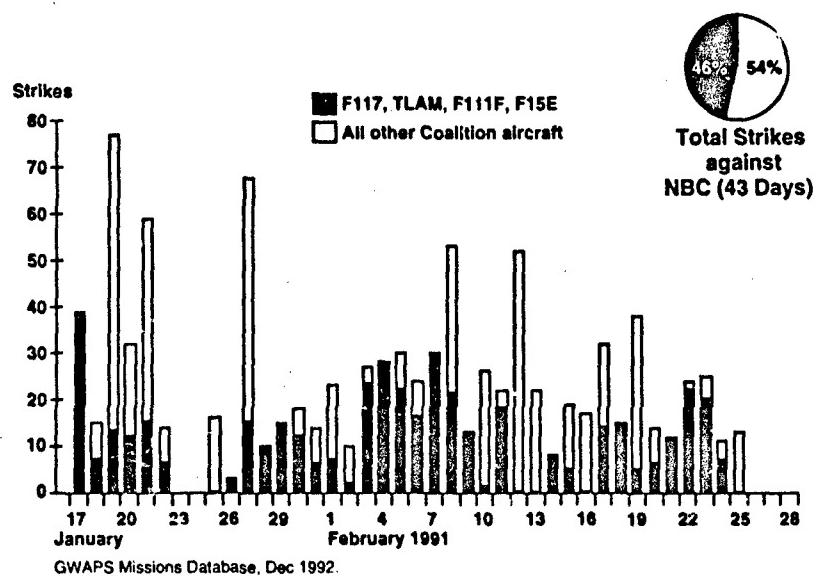
Overall, the United States did not fully understand the target arrays comprising Iraqi nuclear, biological, chemical, and ballistic missile capabilities before the Gulf War. The Iraqis had, in fact, made these target systems as elusive and resistant to accurate air attack as possible, with some success.

⁵¹ Security Council, Rpt S/23215, 7th IAEA on-site inspection (11-22 October 1991), 14 Nov 1991, pp 8 and 63.

⁵² Intvw, GWAPS with Gen Glosson, 9 Apr 1992. The GWAPS Missions Database confirms that several hundred sorties were sent against Scud targets during the first four days of the air campaign.

Figure 16 shows the flow of Coalition air strikes against the Iraqi nuclear, biological, and chemical (NBC) targets that made up the Black Hole's "C" target category. In all, the Coalition mounted some 970 strikes against this category. More than 40 percent of the strikes were made with precision weapons, and about 80 percent of those strikes with precision weapons were carried out by F-117s. Aircraft making strikes with nonprecision weapons against NBC targets included B-52s, F-16s, F/A-18s, GR-1s, F-111Es, and A-6s. In addition, F-111Fs and F-15Es conducted a few nonprecision-weapon strikes on these targets.

Figure 16
**Coalition Strikes against Nuclear, Biological,
 and Chemical Targets**



The bulk of the strikes directed against the C or NBC target category focused on Iraqi chemical-warfare capabilities. Target facilities included the three chemical precursor production facilities near Al Fallujah, research centers such as Salman Pak (which was also associated by Coalition intelligence with Iraqi work on biological toxins), and chemical-munitions production facilities such as Samarra. Suspected storage bunkers for

chemical weapons were scattered throughout Iraq, and some of these, notably the "S shaped" bunkers seen primarily at airfields, had unique signatures. By the time the war began, Coalition intelligence indicated that chemical-warfare units might be operating from Kuwaiti airfields, which transformed virtually all the hardened shelters on those bases into potential storage facilities for chemical munitions. All in all, Iraqi chemical-warfare capabilities offered a large number of potential aimpoints.

Despite Coalition attacks on the chemical-weapons targets, postwar inspections by United Nations Special Commission teams eventually uncovered some 150,000 chemical munitions.⁵³ Why, with such a stockpile, did Iraq not use chemical weapons during Desert Storm? One likely answer is that Iraq feared the Coalition's potential for retaliation more than it did the Coalition's destruction of its chemical-warfare capabilities.⁵⁴ However, the portion of the effort aimed at destroying research, development, and production facilities for chemical munitions began the process of eliminating Iraq's ability to threaten its regional neighbors with weapons of mass destruction. Furthermore, the attrition of artillery in demoralized Iraqi frontline units eventually rendered any coordinated, systematic use of chemical munitions difficult to execute against the initial penetration of Iraqi defenses. Even though air attacks against Iraq's chemical-warfare capabilities fell well short of destroying them completely, it by no means follows that these attacks were militarily futile or served no purpose.

⁵³Iraq's initial postwar declaration to the UN on 18 Apr 1991 acknowledged nearly 10,000 nerve-gas warheads, some 1,500 chemical-weapon bombs and shells, and 1,000 tons of nerve and mustard gas (Kay, "Arms Inspections in Iraq: Lessons for Arms Control," p 1). By the end of 1992, Iraq had admitted to 150,000 chemical munitions, and the head of the CIA believed that the Iraqis still possessed additional munitions that United Nations inspectors had not found (Robert Gates, "Proposed Remarks to the Comstock Club," 15 Dec 1992, p 12).

⁵⁴Asked during a 27 Feb 1991 press conference why the Iraqis had not used chemical weapons, Gen Schwarzkopf speculated that air attack, particularly of the artillery in frontline Iraqi units, had probably limited their capability to employ such weapons; he also raised Iraqi fears of nuclear retaliation as a possible explanation ("Excerpts from Schwarzkopf News Conference on Gulf War," *The New York Times*, 28 Feb 1991, p A8). However, Gen Schwarzkopf's bottom line was that, while he might never know the answer, he was thankful that chemical weapons had not been used. Much the same view was reiterated in the Defense Department's final report on the Gulf war (*Conduct of the Persian Gulf War*, p 155).

How effective was Coalition bombing of Iraq's biological-warfare program? Two basic types of biological-warfare targets were attacked during the air campaign: (1) infrastructure targets such as the Salman Pak and Taji research facilities and Iraq's suspected production plants for biological weapons (one at Al Latifiyah and two near Abu Ghurayb), and (2) the specially designed, refrigerated bunkers scattered throughout Iraq suspected of containing biological or other special weapons.⁵⁵ Although the facilities were destroyed, United Nations inspectors could not confirm after the war that the Iraqis had actually produced any biological weapons before 17 January 1991. As in the case of attacks on chemical weapons, however, attacks against known or suspected research and development facilities for biological weapons served the long-term goal of reducing Iraq's postwar threat to its neighbors.

The relationship of weapons delivered on aimpoints to achievement of operational and strategic effectiveness was particularly strained in the case of the Iraqi nuclear program. We now know that the Iraqis' program to amass enough enriched uranium to begin producing atomic bombs was more extensive, more redundant, further along, and considerably less vulnerable to air attack than was realized at the outset of Desert Storm. Moreover, Iraqi willingness, once the war began, to take such unorthodox measures as disposing nuclear fuel or critical machinery from known nuclear installations like Al Tuwaitha quickly made Iraq's nuclear program even less vulnerable to bombing, no matter how accurate, than it had been during Desert Shield. In this sense, elements of the Iraqi nuclear program were transformed into targets that could be, and were, mobile. Bombing known locations, therefore, failed to achieve the objective of eliminating the existing Iraqi nuclear weapons program. The Iraqi nuclear program's redundancy, advanced status on the eve of the war, and elusiveness, in conjunction with the extraordinary measures the Iraqis took immediately after Desert Storm to conceal its extent by destroying certain facilities, led the United Nations to conclude that the air campaign no more than "inconvenienced" Iraqi plans to field atomic weapons.⁵⁶

⁵⁵Some eighteen bunkers were known before to the war, and others were discovered during the course of the campaign. Not all of those eventually identified were hit before the cease-fire.

⁵⁶The judgment that the bombing at most "inconvenienced" the Iraqi nuclear program was offered by an American who participated in some of the IAEA inspection teams that went into Iraq under UN Resolution 687 in 1991.

Efforts by Coalition air forces to suppress Iraqi launches of Scud missiles against Israel, Saudi Arabia, and other Gulf nations during Desert Storm ran into many of the same problems evident in the case of the Iraqi's nuclear weapons program. Key portions of the target set—notably the presurveyed launch sites and hiding places used by the mobile launchers—were not identified before 17 January 1991, and, even in the face of intense efforts to find and destroy them, the mobile launchers proved remarkably elusive and survivable. Although Iraq's average weekly launch rate of modified Scuds during Desert Storm (14.7 launches per week) was lower than it had been during the 1988 "war of the cities," and while launch rates generally declined over the course of the Gulf War, the actual destruction of any Iraqi mobile launchers by fixed-wing Coalition aircraft remains impossible to confirm. Coalition aircrews reported destroying around eighty mobile launchers,⁵⁷ another score or so were claimed by special operations forces.⁵⁸ Most of these reports undoubtedly stemmed from attacks that did destroy objects found in the Scud launch areas. But most, if not all, of the objects involved now appear to have been decoys, vehicles such as tanker trucks that had infrared and radar signatures impossible to distinguish from those of mobile launchers and their associated support vehicles, and other objects unfortunate enough to provide "Scud-like" signatures.

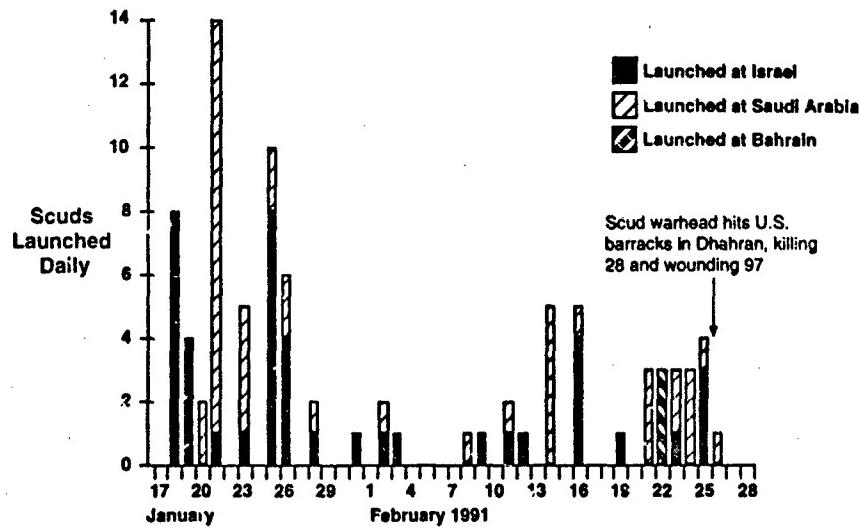
Over the 43 days of Desert Storm, roughly 1,500 strikes were carried out against targets associated with Iraqi ballistic missile capabilities. This total includes missions reported as having bombed mobile launchers (TELs and MELs), suspected hiding places for the mobile launchers (highway culverts, overpasses, etc.), fixed launch sites (such as those at the H-2 airfield in western Iraq), and Scud-related production and support

⁵⁷ Immediately after the war, the A-10s alone claimed to have destroyed 51 Scud launchers ("Operation Desert Storm: A-10 Combat Recap: 23/354 TFW(P), 17 Jan 1991 to 28 Feb 1991," slide entitled "A-10 Mission Results: Targets Destroyed—Confirmed," GWAPS, NA 292). F-15Es were reported by Gen Schwarzkopf to have destroyed 6-10 mobile launchers on the night of 29 Jan 1991 (DOD, "Special Central Command Briefing," Riyadh, Saudi Arabia, 30 Jan 1991, transcript #67256!). Hence, an estimated total of some 80 mobile launchers claimed to have been destroyed by Coalition aircrews is consistent with wartime claims, as well as information presented during a GWAPS visit to Nellis AFB, NV, in Feb 1992.

⁵⁸ GWAPS members visited the U.S. Special Operations Command in March of 1992.

facilities.⁵⁹ Nearly half of the approximately 1,500 "Scud" strikes delivered ordnance against either fixed sites or structures such as culverts and highways overpasses suspected of being potential hiding places for mobile launchers; some 30 percent struck ballistic missile production and infrastructure; only 15 percent—just over 215 strikes—were reported to have involved attacks on mobile launchers.⁶⁰ The last percentage—particularly when placed alongside the roughly 1,000 "Scud patrol" sorties that dropped on targets other than Scud—begins to give a quantitative sense of how elusive Iraq's mobile launchers proved to be. The numbers also confirm, however, that the diversion of air assets to the "great Scud chase" was not large relative to over 42,000 strikes recorded during the war by Coalition fixed-wing aircraft.

Figure 17
Daily Scud Launches during Desert Storm (Riyadh time)

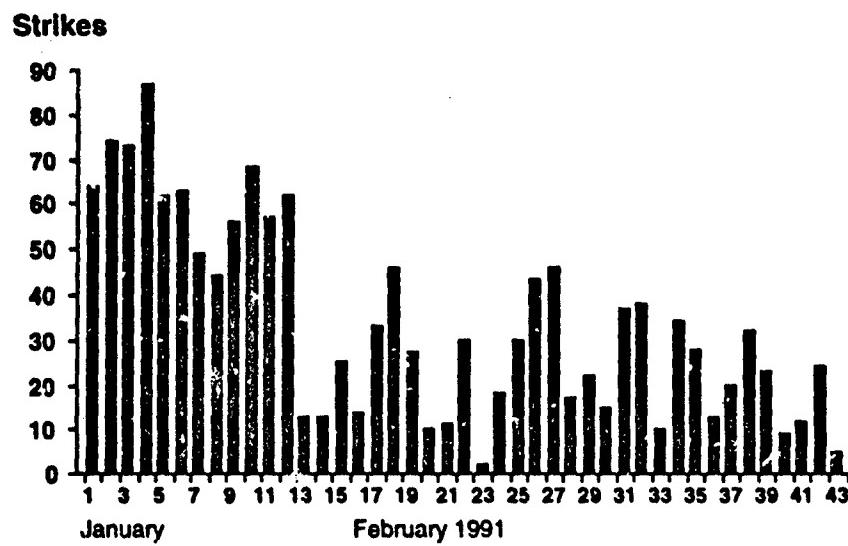


Source: Thomas P. Christie, William J. Barlow, et al., "Desert Storm Scud Campaign (U)," IDA paper P-2661, Apr 1992, SECRET NF.

⁵⁹The "AIF" total for Scud strikes/sorties in the GWAPS Mission Database is substantially lower than the roughly 2,500 Scud sorties widely reported after the Gulf War [see, for example, Richard P. Hallion, *Storm Over Iraq: Air Power and the Gulf War* (Washington, DC: Smithsonian Institution Press, 1992), p 181]. The principal reason for this difference stems from "Scud patrol" missions that were *launched* to hunt mobile Scuds but, when unable to locate any, "dropped on" other targets of opportunity. This example also illustrates the kinds of problems that infected many of the figures concerning the Desert Storm air campaign that were circulated in the immediate aftermath of the war.

⁶⁰GWAPS Missions Database, 14 Dec 1992.

Figure 18
Coalition Strikes Against Scuds



As a result, the initial hope of the air planners in Riyadh that heavy attacks on the fixed Scud sites during the opening hours of the air campaign would largely eliminate Iraq's capability to launch ballistic missiles against Israel or regional members of the U.S.-led Coalition proved to be illusory.⁶² The fixed Scud launchers in western Iraq functioned, on the night of 16-17 January 1991, as "decoys" that diverted attention away from the mobile launchers that had already deployed to their wartime "hide" sites, and the first of Iraq's extended-range Scuds were fired at Israel the following night.⁶³

Once Scuds started falling first on Israel and on Saudi Arabia two days later, the next best military option would have been to locate and attack mobile launchers before they had time to fire. Soviet exercise patterns in central Europe with Scud-Bs and Iraqi practice during the Iran-Iraq war indicated that if the Iraqis followed prior practices, there might be enough prelaunch signatures and time to give patrolling aircraft some chance of attacking mobile launchers before they fired. During the Gulf War, however, the Iraqis dramatically cut their prelaunch set-up times, avoided any prelaunch electromagnetic emissions that might give away their locations before launch, and seeded the launch areas with decoys (some of which were very high fidelity⁶⁴) and other vehicles.

The next tactical option was to mount airborne "Scud patrols" in the hope that, once launches were detected, the strike aircraft would be able to identify the firing locations quickly enough to acquire the launchers with onboard sensors and destroy them before they could leave the scene. The link in this chain that proved to be the most difficult to close was the ability of the sensors on strike aircraft to identify and acquire vehicles whose radar and infrared signatures were easily masked and extremely difficult to distinguish on any reliable basis from background clutter,

understood by air planners in Riyadh as pointing to widespread dispersal.

⁶²Getting F-15Es and other strike aircraft cleanly through Iraq's air defense during the opening moments of the air campaign so that they could strike the fixed Scud launchers in western Iraq was a central feature of the master attack plan for ATO Day 1.

⁶³The first launches against Israel occurred around 0300 on the morning of 18 Jan 1991, Riyadh local time.

⁶⁴United Nations observers, who eventually oversaw the destruction of both mobile launchers and decoys, reported that the high-fidelity decoys were impossible to distinguish visually from the real thing outside of 25 yards—even on the ground. The Iraqis also made use of relatively low-fidelity decoys.

trucks and other vehicles, or countless objects located within the Scud launch areas in western and southeast Iraq.

Over eighty percent of the Scud launches during Desert Storm occurred at night. Even an F-15E orbiting near a fleeting target the size of a MAZ-543 mobile launcher had little chance of identifying and acquiring the vehicle before it reached a "hide" site. The clearest evidence of this can be drawn from the forty-two occasions on which Scud launches were visually observed by orbiting strike aircraft. In only eight of these cases were aircrews of strike aircraft able to visually acquire the target sufficiently to deliver ordnance.⁶⁵ Even allowing for the long distances at which a Scud launch could be seen at night, aircraft such as F-15E and the FLIR-equipped F-16L experienced fundamental sensor limitations that rendered the probability of finding Iraqi mobile launchers extremely low—even when the launch point could be localized into a relatively small area in near real time by either aircrew visual sightings or offboard sensors providing coordinates.

Some eighty-eight extended-range Scud variants were launched at Israel, Saudi Arabia, and Bahrain during Desert Storm. Thirty-three of the eighty-eight launches occurred within the first seven days of Desert Storm. Hence, the number of launches over the remaining thirty-six days of the war—a total of fifty-five firings—reflects over a threefold lower average level of activity (1.5 launches per day versus an average of 4.7 launches per day during the first week); it is reasonable to attribute this reduction in the average number of daily launches to the "Scud hunting" efforts of Coalition aircraft.

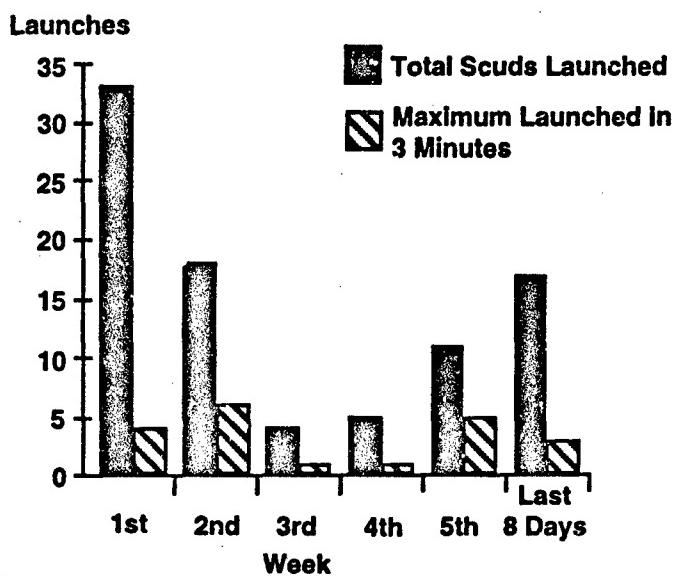
Nevertheless, the maximum number of Scud launches on any single day—fourteen—does not exceed the total number of mobile launchers known to have survived the war.⁶⁶ So the observed launch data are very consistent with the possibility that the Iraqis started the war with a total mobile-launcher inventory in the high twenties to mid-thirties. Furthermore, the period of lowest activity spans the third and fourth weeks of the war, and Iraq's Scud units seemed to have recovered somewhat during the final two weeks of the campaign. This pattern can be seen more easily in the

⁶⁵(S) Defense Science Board (DSB), Office of Director of Research and Engineering, "Lessons Learned during Desert Shield and Desert Storm," "For comment draft," May 1992, p 72.

⁶⁶The total number of mobile launchers known to have survived the war is 19.

week-by-week launch totals depicted as solid bars in Figure 19. Relative to the first week, the weekly launch totals reflect a substantial reduction of Scud launches through the fourth week. But the solid bars in Figure 19 indicate that some degree of recovery occurred in the fifth week, and the launches during the last eight days of the war are comparable with the total numbers of Scuds launched during the second week.

Figure 19
By-Week Launch Totals and
Maximum Salvo Size for Iraqi Scuds



Source: Christie, Barlow, et al., "Desert Storm Scud Campaign (U)," IDA P-2661, Apr 1992, SECRET NF.

A somewhat similar story emerges from considering the maximum salvo size in each week. The striped bars in Figure 19 depict the maximum salvo size, which has been somewhat arbitrarily defined as the maximum number of missiles fired within a three-minute period during a given week. This measure attempts to represent the Iraqis' potential to overwhelm Patriot defenses by putting a large number of missiles on Saudi Arabia or Israel within ninety seconds. The by-week data suggest that after the low launch rates of the third and fourth weeks, the Iraqi Scud units recovered enough in the fifth week to launch a salvo size

comparable to that of the second week. For the final eight days, the salvo size decreased—again presumably because of the pressure put on Scud units by Coalition forces—but was still greater than that achieved during the third and fourth weeks.

There were, of course, areas in which the Desert Storm air planners reached fairly accurate assessments of how the Iraqis might plan against or respond to air attack. The reactions of Iraqi surface-to-air missile defenses in Baghdad to decoys and HARMs on the opening night, and the possibility that the Iraqi air force would not seriously contest air superiority in the opening days of the air campaign, constitute instances in which the Coalition assessed Iraqi behavior with reasonable accuracy before 17 January 1991. In the case of the Iraqi Scud units, however, the evidence suggests that a series of incorrect assumptions was made by intelligence analysts, air planners, and commanders alike. Furthermore, the way the Scud hunt unfolded tended to mask these errors well into the air campaign. In the first ten days or so, aircrews made substantial claims of Scud mobile launcher kills, backed up in some cases by vivid video footage from airborne recording systems. The lull in launches during the third and fourth weeks probably gave hope that a good portion of the kill claims were legitimate. In such circumstances, it should not be surprising that a full picture of the history and extent of the Iraqis' Scud-decoy program was not developed until some months after the war ended.

In retrospect, nothing in the launch or other data bearing on the anti-Scud effort is incompatible with an Iraqi Scud force that had, at most, thirty or so mobile launchers at the start of the war. Certainly, Scud-hunting operations by Coalition aircraft and special forces harassed the launch operations of these units. More importantly, in conjunction with the perceived effectiveness during the war of Patriot in defending against incoming Scuds, the Iraqi Scud campaign failed in its strategic purpose of fracturing the U.S.-led Coalition. Nevertheless, the fundamental sensor limitations of Coalition aircraft, coupled with the effectiveness of Iraqi employment tactics (including the use of decoys), suggest that few mobile Scud launchers were actually destroyed by Coalition aircraft or special forces during the war. Given the level of effort mounted against mobile launchers, a few may have been destroyed, but nowhere near the numbers reported during the war. Once again, there is no indisputable proof that Scud mobile launchers—as opposed to high-fidelity decoys, trucks, or

other objects with Scud-like signatures⁶⁷—were destroyed by fixed-wing aircraft. So beyond the disruption induced by the level of effort put into the hunt for the launchers, Coalition air power does not appear to have been very effective against this militarily insignificant target category.

The Strategic “Core” in Retrospect

Regardless of the private hopes airmen may have had during the Gulf War that air power might achieve the Coalition's military objectives without a ground campaign,⁶⁸ the modest fraction of the air-to-surface attacks focused against the strategic core concentrated primarily on the more pragmatic objectives laid out in this and the previous chapter. Planners wished to exert pressure from the outset directly against the heart of Iraqi power, an idea consistent with other strategic bombing campaigns.⁶⁹ Strategic air attacks were in some cases less effective than air planners had hoped for or believed, as in the case of the Iraqi nuclear weapons program—by mid-1992, for example, UN Security Council inspection teams had identified and destroyed more of Iraq's nuclear missile programs than had the air campaign.⁷⁰ In other cases, such as that of Iraq's electrical power system, the Coalition met its immediate military objectives. In yet other cases such as the L and CCC target categories, effectiveness cannot be precisely estimated.

⁶⁷For example, on 30 Jan 1991 the videotape from an F-15E “Scud hunt” mission was shown at a U.S. Central Command press conference as proof of Coalition success. While it was confidently asserted on this occasion that at least three—and possibly seven—of the vehicles in question were mobile launchers, it appears far more likely that the objects were in fact commercial fuel trucks (DOD, “Special Central Command Briefing,” Riyadh, Saudi Arabia, 30 Jan 1991, transcript #672561; also, discussions with DIA analysts and Air Force officers who were involved in bomb damage assessment during the war and saw the tape when it was broadcast over CNN).

⁶⁸Asked if he had hoped that the Iraqis might quit before the ground offensive, Gen Horner replied, “Of course. I’m an airman.” (GWAPS intvw, Shaw AFB, NC, 10 Mar 1992).

⁶⁹Noble Frankland argued in 1963 that the core idea behind the strategic air offensive against Nazi Germany during World War II—namely, to put pressure directly on the heart of the enemy nation—was, especially for Great Britain, a logical successor to a naval blockade [Noble Frankland, *The Bomber Offensive against Germany: Outlines and Perspectives* (London: Faber & Faber, 1965), pp 21, 25].

⁷⁰Kay, “Arms Inspections in Iraq: Lessons for Arms Control,” p 5.

Air Attacks on the Iraqi Surface Forces

The vast weight of the Coalition air effort in the war flew either directly against Iraqi ground forces in the Kuwait theater or against the supply lines to those forces. These ground forces absorbed the preponderance of the attack sorties of the war and an even larger proportion of the bomb tonnage. This portion of the air war was characterized by the gradual attrition of Iraqi forces rather than by a sudden change in Iraqi capabilities, such as had characterized the attacks on the Iraqi air force, air defense system, and electrical power grid. Bomb damage assessment focused more on measuring the cumulative effort of many sorties over time than on scoring the successes of individual sorties.

The planners of air attacks against the Iraqi army recognized the important status of the Republican Guard units, but those forces proved a difficult target. They were singled out as a center of gravity for the part they played as the strategic reserve in the Iraqi ground scheme of maneuver and for their political role as defender of Saddam Hussein's regime. Central Command planning, in fact, addressed the possibility of staging an earlier-than-planned ground attack if it discovered that Republican Guard forces were about to retreat into the interior of Iraq before the planned ground offensive got underway. Fearing an early withdrawal, General Schwarzkopf directed that bridges be struck early in the air campaign (in Phase I), not simply to stop the flow of supplies into the theater but to block the retreat of the Guards.⁷¹ Still, the position of these forces, which were the farthest back in the theater, made them the most difficult units to observe and to attack and allowed several of the Republican Guard divisions to be among the least damaged Iraqi units by the end of the war.

The bombing altitudes employed by the Coalition aircraft limited both the prosecution and effectiveness of the air campaign in the Kuwait theater. Crews bombed from much higher altitudes than those at which they had trained in order to remain above the effective altitude of the antiaircraft artillery and infrared SAMs. As a result, aircraft delivering unguided munitions lost accuracy because of the greater slant ranges to the targets and the resulting magnification of aiming errors. Some of the

⁷¹(S) Hq. U.S. Central Command, Combined Operation Desert Storm, 17 Jan 1991, para 3.f.(1)(b)3, GWAPS, CHP 18-1.

munitions operated best when released at lower altitudes (particularly the cluster mines or bomblets) and were thus less effective because of their excessive dispersion pattern when released from higher altitudes. In addition, aircrews had a much greater problem in identifying targets and assessing damage.⁷² Precision weapons did not suffer as much from changes in release altitudes.

Attacks on the surface forces consisted of several components: (1) air interdiction of supplies and transport to and within the Kuwait theater; (2) attacks on the Iraqi Navy; and (3) the main component, attacks on the Iraqi Army while it remained in place during the air war, during engagements at Al Khafji, and during the ground war.

Air Interdiction

Air interdiction operations aimed to cut the flow of supplies to the Kuwait theater and to stop the movement of forces. Given that most Iraqi ground forces were in the Kuwait theater by the start of the air campaign, the need to block reinforcements was limited. Of greater concern was the need to prevent Iraqi forces from departing the theater intact. Because the principal lines of communications between Baghdad and the theater generally followed and frequently crossed rivers, bridges became the key targets. There were 126 highway bridges and nine railroad bridges south of Baghdad, and by the end of the war, roughly half were included in the Black Hole's "RR" target category. In addition to the bridges, seven rail yards in Iraq also were targeted as transportation chokepoints, but the damage to the yards was not a major factor in eliminating rail traffic between Baghdad and the theater. The destruction of rail bridges was of much greater consequence.

⁷²This subject is treated in depth in the Survey's Weapons, Tactics and Training Report. See also (S) USAF Fighter Weapons Center, "Tactical Analysis Bulletin, Vol 91-2," Jul 1991, GWAPS, NA 216; (S) Headquarters, Strategic Air Command, "B-52 Desert Storm Bombing Survey," 15 Dec 1991, p 33; (S) Frank Schwamb et al, *Desert Storm Reconstruction Report, Vol II: Strike Warfare* (Alexandria, VA: Center for Naval Analyses, 1991), pp 5-24 through 5-29; and (S) U.S. Marine Corps Research Center, "Aviation Operations in Southwest Asia," Research Paper #92-0003, U.S. Marine Corps, Quantico, VA, Jun 1992.

Figure 20
Damaged Bridges in Iraq (DIA)

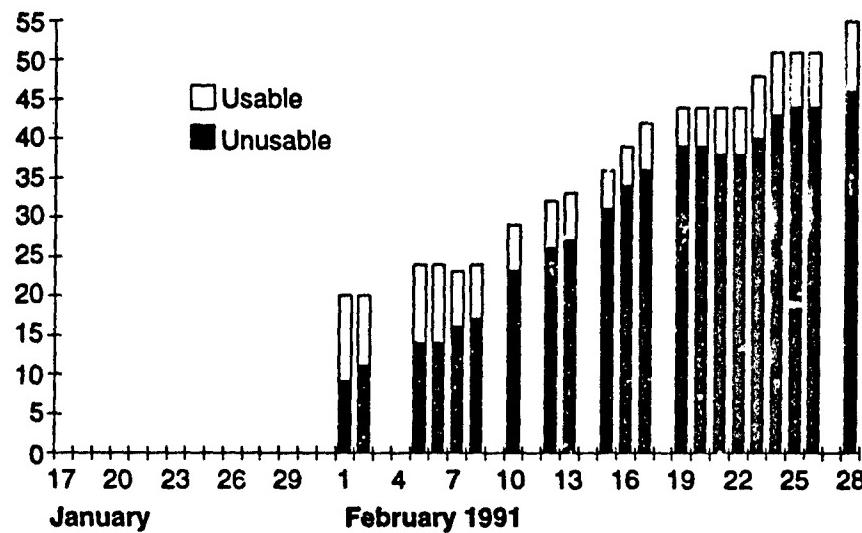


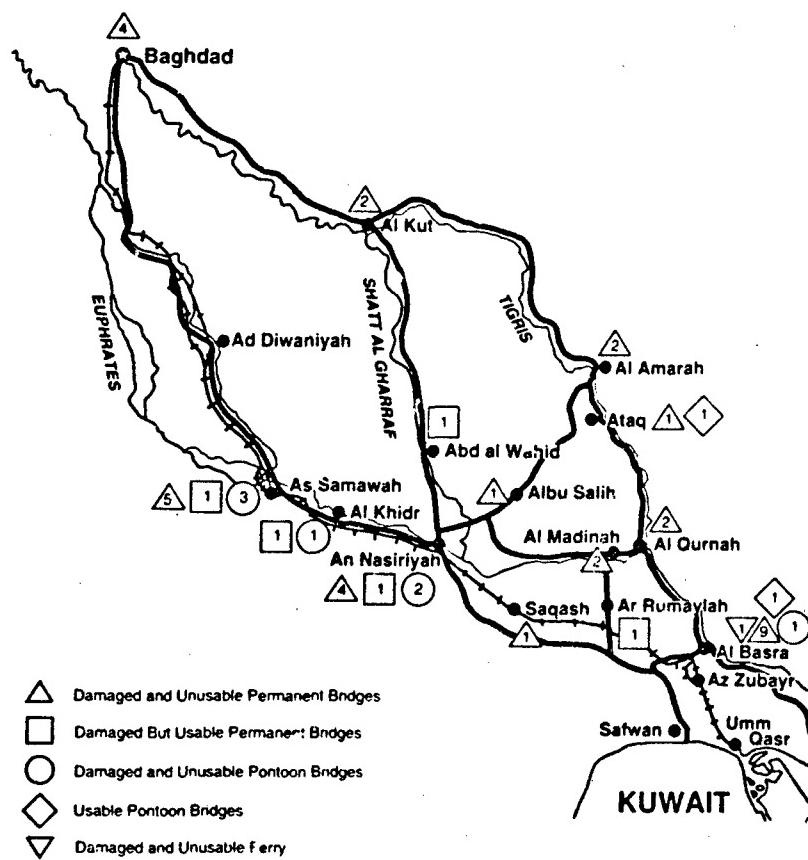
Figure 20 presents the first-order effect of the anti-bridge strikes—a steady increase in the number of damaged bridges in Iraq.⁷³ In most cases, the damage left the bridge unusable. By the time of the cease-fire, thirty-seven highway bridges and nine railroad bridges no longer were usable. Another nine highway bridges were severely damaged, though usable.⁷⁴ As shown in Figure 21, roughly two-thirds of these bridges lay on the lines of communications from Baghdad to the theater. As Samawah, An Nasiriyah, and Basra suffered the largest number of damaged bridges.⁷⁵

⁷³Figure 20 reflects data derived from various Defense Intelligence Agency assessments produced during the Gulf War. Dates correspond to the dates of the DIA documents in which damage to bridges was reported.

⁷⁴(TS) Defense Intelligence Agency, *Final BDA Status Report*, pp 90-91, GWAPS, NA 519.

⁷⁵Figure 21 is based on information derived from *Final BDA Status Report*, pp 90-98; (S) paper, DIA/DB-8B, list of damaged Iraqi bridges, railway yards, and ferry facilities, 24 Feb 1991, DE-8B Desert Shield/Desert Storm Translog; (S/WN) large map with overlay, 28 Feb 1991, DIA/DB-8B; and background paper on Iraq's Logistics.

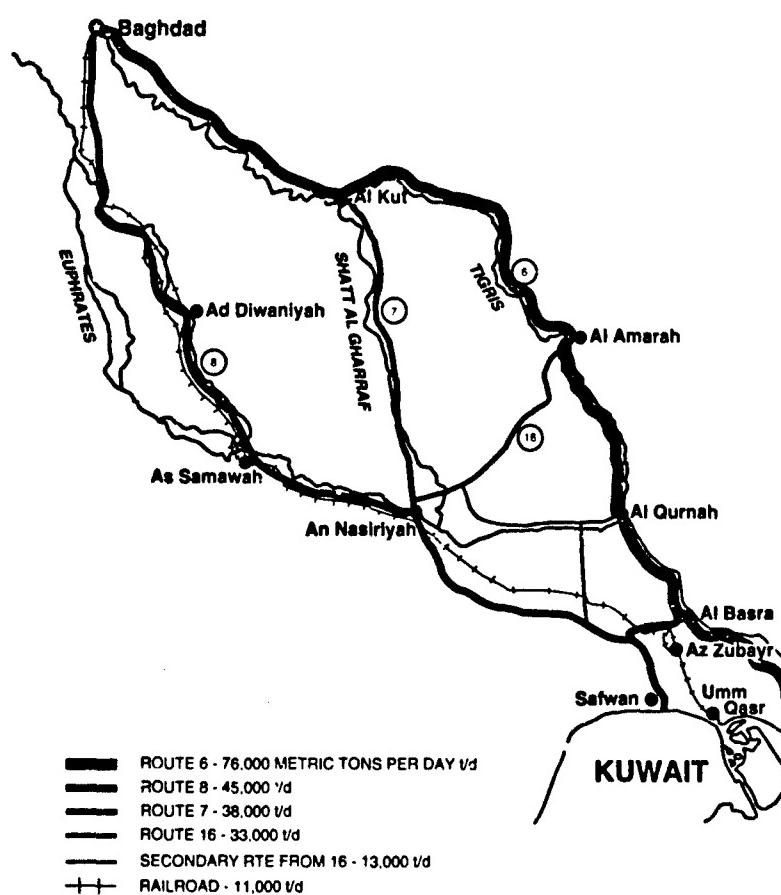
Figure 21
Status of Bridges on Baghdad-to-KTO Routes, 28 Feb 1991



Throughout the war, Iraq attempted to offset the destruction of its permanent bridges by rerouting traffic, constructing temporary bridges, using amphibious ferry vehicles, and building earthen causeways. The Iraqis did not attempt to repair major structural damage to bridges, perhaps because of the brevity of the conflict and the threat of further strikes. Resupply traffic moving south used secondary routes to bypass damaged bridges, but rerouting became more difficult as bridge damage spread. The skill the Iraqis exhibited in coping with the destruction of their permanent bridges led General Horner after the war to caution,

Anybody that does a campaign against transportation systems [had] better beware! It looks deceptively easy. It is a tough nut to crack. [The Iraqis] were very ingenious and industrious in repairing them or bypassing them. . . I have never seen so many pontoon bridges. [When] the canals near Basra [were bombed], they just filled them in with dirt and drove across the dirt.⁷⁶

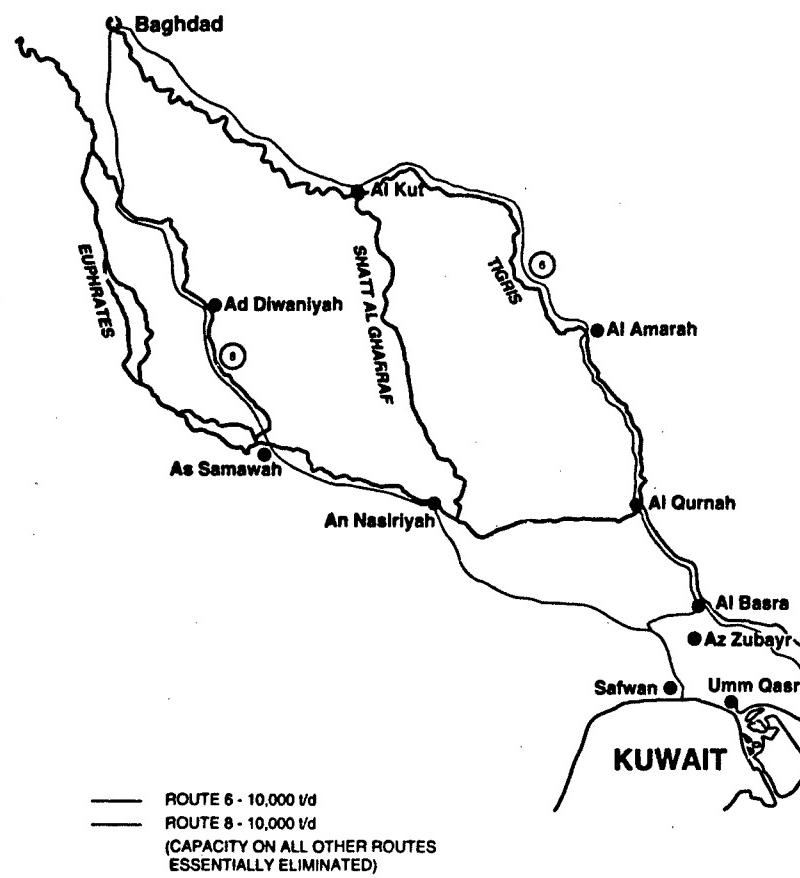
Figure 22
Prewar Baghdad-to-KTO Route Capacities



⁷⁶(S) Intvw, Perry Jamison, Richard Davis, and Barry Barlow, Air Force History Program, with Lt Gen Charles A. Horner, 4 Mar 1992, GWAPS, NA 303, pp 49-50.

Decreases in the capacities of individual routes to the Kuwait theater can be seen in Figures 22 and 23.⁷⁷ Note that the thickness of each highway line (as well as the line for the railroad) is proportional to its relative capacity. By the end of the war, all but Routes 6 and 8 effectively were closed, and even those two retained only fractions of their prewar capacities.

Figure 23
Baghdad-to-KTO Route Capacities, 28 Feb 1991



⁷⁷Data for the figures were derived from *Final BDA Status Report*, pp 93-97; background paper on Iraq's Logistics.

The capacity of the Baghdad-to-Basra rail line was entirely eliminated by the bridge damage described previously. The loss of the rail line was potentially more significant than these numbers alone would suggest, for before the air war, it was the principal means for transporting armor and self-propelled artillery from central Iraq to the Kuwait theater. After the line was closed, these vehicles could have used the highways, but only with great difficulty.⁷⁸

During February, various strike aircraft (notably F-16s) flew armed reconnaissance missions along sections of the main highways leading into the Kuwait theater. Besides destroying trucks and their cargo, "road recce" forced the enemy to take steps that hampered resupply. Iraqi countermeasures to deal with the air threat led to the diminution of the supply flow. By the third week in February, resupply movements were largely restricted to the night hours, as Iraqi vehicles sought refuge in the darkness.⁷⁹ The capability of Coalition aircraft to operate at night, however, undercut the effectiveness of this standard response to air interdiction. In addition, Iraq shifted from multivehicle convoys to single trucks to make its supply transports less detectable and lucrative targets for Allied aircraft.⁸⁰ Yet, this change also reduced the supply tonnage reaching the theater each day.

Attacks on Iraqi stockpiles and transportation *within* the Kuwait theater completed the effort to cut off the theater from Iraq. Here there were few bridges or chokepoints; instead, the attacks fell on the trucks deployed with units and those making supply runs. Information from EPW (enemy prisoner of war) reports suggests that air attacks eliminated more than half the trucks in the theater. The reports indicated that most of the trucks broke down for want of spare parts, or were destroyed by air attacks, or that drivers eventually refused to travel the roads in the theater.

⁷⁸(S/NF/REL/UK/SA/WN) Rpt, Intelligence and Threat Analysis Center, U.S. Army Intelligence Agency, *Iraqi Resupply and Sustainability*, ATC-WP-1150-032-91, Nov 1990, p 3, GWAPS, CIM Folder 46; (S/NF/REL/UK, CAN, AUS WN) Memo, Dimon to Distribution, 7 Feb 1991.

⁷⁹(TS/NF/SPECAT) Brfg, J-2 Daily BDA Assessment for Operation Desert Storm, 19/20-23/24 Feb 1991, GWAPS, NA 353.

⁸⁰(S/NF) Rpt, Defense Intelligence Agency, *Persian Gulf War: Trends and Outlook (19-24 Feb 1991)*, Defense Intelligence Memo 61-91, Feb 1991, p 3, GWAPS, CBDA Folder 37.

The effects on the Iraqi army units, as in other cases, were mixed. Prisoner of war reports from frontline forces showed a general pattern of units low on food and water and lacking in resupply capability. At the same time, there were reports of units having plentiful supplies of water and hot meals. Prisoners captured at Al Khafji were described as being in wretched health and malnourished but wearing new uniforms and boots; in the Republican Guard areas, on the other extreme, U.S. VII Corps soldiers found trailers of quality foods such as canned mackerel and crackers.⁸¹ The pattern that emerges from the evidence is not of a starving army but an organization in which the distribution system had ceased to function: distributions appeared illogical, and goods were generally absent, hoarded, or lying unused. The policy of the Iraqi army not to use radios or telephones, combined with a beleaguered transportation system, would, of course, accentuate this condition.

While the Coalition undertook to isolate the Iraqi army from communications with Baghdad, in-theater efforts were aimed at preventing divisions and corps from communicating with one another, thereby preventing the theater and strategic reserves from reacting promptly to the Coalition ground attack. The communications targets, however, proved difficult to attack successfully; even when they were hit, the extent of damage was difficult to assess. Iraqi countermeasures were successful but costly.

Prisoner of war reports often describe Iraqi measures to preserve their equipment. Measures included using messengers, prohibiting the use of radios after the start of the air attacks, and even pronouncing death sentences for those who used two-way radios or telephones. Also, the Iraqis laid extensive wire, buried throughout the theater to preserve emergency communications. Wire was strung between units, which were sometimes as far apart as fifty kilometers. Bombing cut the wire at times, but Iraqis often repaired these lines within a day. Effective communication, however, required more than the ability to warn another unit of attack; if the warned unit could not undertake some sort of coordinated action in response, the warning was of little value. Here, the system collapsed. Reports show that once the units tried to move, wire strung between units no longer sufficed, and the lack of communications became debilitating—units either tried to talk, unsuccessfully, on radios susceptible to jamming

⁸¹(S) Battlefield Reconstruction Center, Asst Chief of Staff, G2, Hq, VII (U.S.) Corps, "Battlefield Reconstruction from Enemy Perspective (24-28 Feb 1991)," p 47.

or simply did not attempt to communicate with one another.⁸² Reports after the battle at Al Khafji provided examples of Iraqi units lost in the desert or unable to coordinate actions with jammed communications.

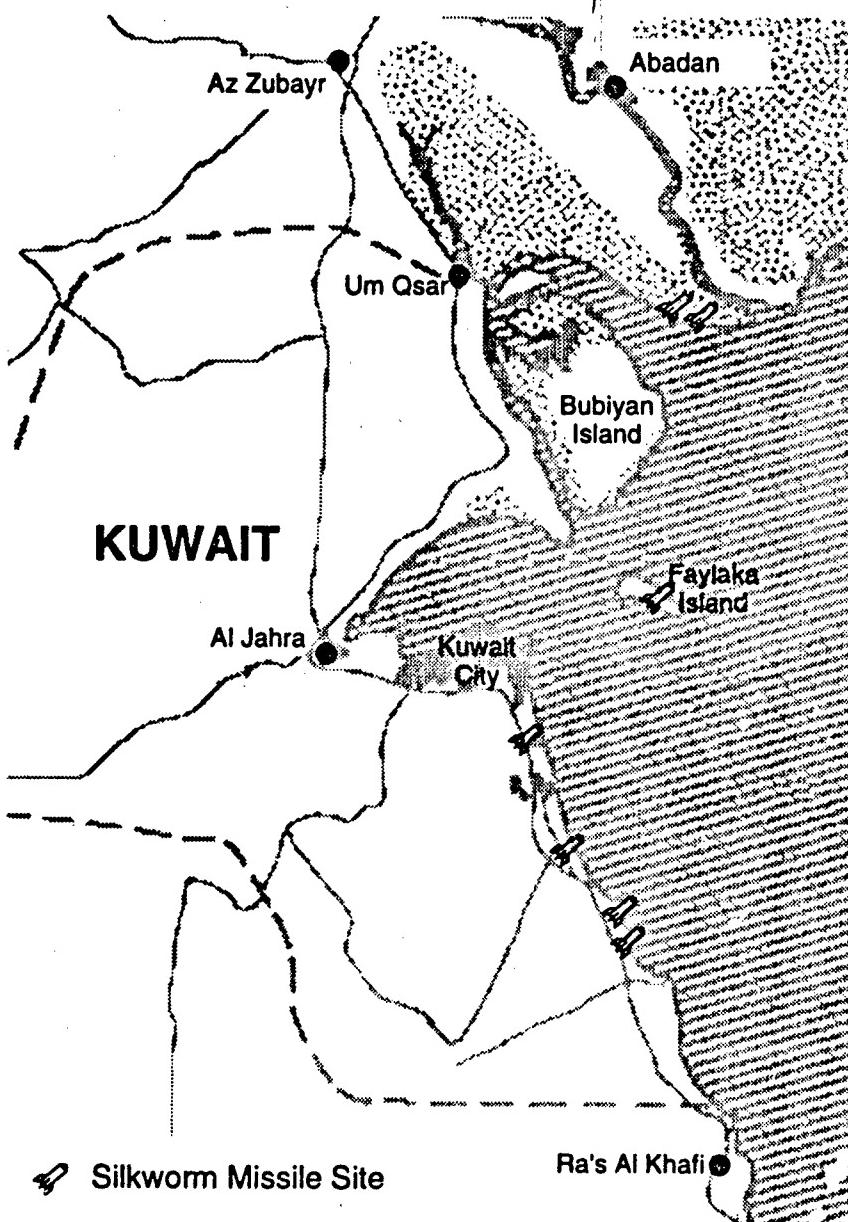
Given the above evidence of the effects of Coalition air attacks against Iraqi supply lines both to and within the theater, what conclusions can be drawn regarding the operational effectiveness of air interdiction in Desert Storm? Strikes against key bridges on the main lines of communication between Baghdad and Basra, as well as armed reconnaissance flights along those routes, succeeded in reducing the flow of supplies to the Iraqi army, even if the aircraft weapons did not completely sever those lines and totally isolate the theater. Because of the limited requirements of an essentially inert army, the overall capacity of the supporting transportation net, and the use of countermeasures (temporary bridges and alternate routes), Iraq was able to move sufficient supplies to the Kuwait theater in the weeks before the ground war, despite the air campaign. Whether several more days or weeks of air interdiction operations alone would have eliminated all resupply of the theater is a matter of speculation. What is certain is that the outbreak of large-scale ground combat increased the demand for supplies (especially ammunition and POL) to the point where the residual route capacity and daily supply flow would not have been sufficient to sustain the Iraqi army in a prolonged conflict.

Attacking the Iraqi Naval and Coastal Defense Forces

Coalition aircraft attacked Iraqi naval targets to secure freedom of action in the northern Persian Gulf. The Iraqi Navy was small, but the presence of even small missile-firing boats posed a threat to Coalition battle groups and amphibious forces. Carriers and battleships carried firepower to support the ground attack, and the amphibious forces had to be in position to carry out the strategic deception plan and be ready for landings, if necessary. The targets included Iraqi ports and facilities at Basra, Az Zubayr, and Um Qasr; numerous operating locations in Kuwait and on islands; oil terminals; Silkworm missile sites along the coast (see Figure 24); and a fleet of

⁸²U.S. signals intelligence personnel depicted the Iraqi army as having committed "Emcon (emissions control) Suicide."

Figure 24
Fixed-Site Iraqi Naval Targets



patrol boats, missile-firing boats, and mine-laying boats. Of 178 vessels, the 13 Iraqi missile boats posed the greatest threat.⁸³

U.S. Navy aircraft prosecuted the attacks against the Iraqi Navy, assisted by Great Britain's Royal Navy attack helicopters; other Coalition aircraft attacked the naval facilities. The aircraft carriers involved were the *Midway*, *Theodore Roosevelt*, and *Ranger*, with the *America* joining on 15 February. Just as in the case of targets on land, the lack of adequate bomb damage information prevented timely assessment of the damage to the Iraqi boats. Later analysis showed that all of Iraq's missile boats had been damaged or destroyed by 2 February 1991, except for one that escaped to Iran, but the Navy's antisurface warfare commander could not declare the threat defeated until 17 February.⁸⁴ Even after the threat was eliminated, however, numerous maritime strikes took place on the many patrol boats that remained on Faylak Island, Bubiyan Island, and coastal artillery positions and Silkworm missile sites. As a result of all engagements, 143 Iraqi boats were damaged or destroyed, including 12 of the 13 missile boats. On the eve of the ground attack, however, only 2 of the 7 known Silkworm sites (5 of them in Kuwait) were believed destroyed.⁸⁵

The attacks against the Silkworm sites contained many of the same frustrations as in the attacks on Scud sites. Although intelligence identified seven Silkworm sites before the war, repeated strikes on the sites did not remove the threat. There were forty-five strikes in all, beginning at the end of January, and half of those were during the ground offensive. The fixed sites were suspected of being decoys, because an increasing number of strikes were not made against the identified sites, but against suspected sites in adjacent areas.⁸⁶ Only two launches were recorded during the war, from a site south of Kuwait City on 25 February; the missiles were fired probably just before the site's capture: one of the missiles apparently crashed into the sea immediately, and the other was

⁸³(S) Peter P. Perla, *Desert Storm Reconstruction Rpt, Vol I: Summary*, and Jeffrey Lutz, et al, *Desert Storm Reconstruction Report, Vol VI: Antisurface Warfare* (Alexandria, VA: 1991).

⁸⁴(S) Perla, *Reconstruction Report*, p 78.

⁸⁵(S) Lutz, *Reconstruction Report*, p 4-1; (TS) viewgraph, "BDA, Tactical Systems, Naval Forces," J2 Brfg to the President and JCS, GWAPS, NA 353.

⁸⁶(S) Lutz, *Reconstruction Report*, pp 5-6 to 5-8

shot down by a missile fired from HMS *Gloucester*.⁸⁷ Just as for anti-Scud operations, one cannot judge to what extent the attacks suppressed launches. The Iraqis may have retained the missiles for use only in the event of an amphibious landing, or they may simply have lacked sufficient targeting data to attack Coalition ships.

Attrition of Iraqi Ground Forces

Air campaign planners aimed to decrease the combat effectiveness of the Iraqi Army by 50 percent. The quantitative measure of that attrition was destruction of Iraqi armor and artillery to that level throughout the theater. But a variety of factors came into play. The factors included a more extensive target set to attack than simply armor and artillery, fewer sorties than planned, poorer bombing accuracy from the higher release altitudes, and worse-than-planned weather. Perhaps the greatest change from the plan entailed the munitions employed. Prewar planning computed attrition by relying heavily on the use of air-to-surface missiles—Mavericks—by several types of aircraft (F-16, A-10, and AV-8B) and a variety of special munitions.⁸⁸ As Table 3 shows, a significant number of Mavericks were fired, but almost exclusively by A-10s (5,013 of the 5,296 employed by the Air Force). Pilots also used other antiaarmor munitions (CBU-89 and GATOR), but not nearly as many as general-purpose bombs.

Air strikes targeted against Iraqi ground forces started on the first day of the air campaign and continued with increasing intensity throughout the war; apart from daily variations based on weather in the region. Air strikes against Republican Guard divisions and other Iraqi heavy divisions in central Kuwait reached their highest daily totals in the first two weeks of February. Daily totals for air strikes against Iraqi front line divisions peaked just prior to the ground attack on 24 February. Figure 25 displays wartime totals for air strikes against each of the principal kill boxes.

⁸⁷(S) Robert W. Ward, et al, *Desert Storm Reconstruction Rpt, Vol VIII: C3/Space and Electronic Warfare* (Alexandria, VA: Center for Naval Analyses, 1992), pp 4-6 to 4-10.

⁸⁸(S) In addition to Mavericks, CBU-89 (Gator) and 30-mm cannons were planned for use against armor; CBU-52 (fragmentation bomb) and MK-20 (Rockeye) were planned against artillery. Viewgraph, CENTAF/CC Brfg to the SECDEF, 20 Dec 1990, in "Gen Glosson Brief," GWAPS, Box 3-60.

Table 3
Listing of Selected Munitions Employed in Desert Storm*
17 Jan-28 Feb 1991⁸⁹

Munitions	Expended			
	Air Force	Navy	Marine Corps	Total
General-Purpose Bombs				
Mk-82 (500 lb)	59,884	10,941	6,828	77,653
Mk-83 (1,000 lb)		10,125	8,893	19,081
Mk-84 (2,000 lb)	10,467	971	751	12,289
Mk-117 (B-52)	43,435			43,435
CBU-52 (fragmentation bomb)	17,831			17,831
CBU-87 (combined effects munition)	10,035			10,035
CBU-89/78 (Gator)	1,105	148	61	1,314
Mk-20 (Rockeye)	5,345	6,814	15,828	27,987
Laser-Guided Bombs				
GBU-12 (laser/Mk-82)	4,086	205	202	4,493
Air-to-Surface Missiles				
**AGM-114 Hellfire (AH-64 and AH-1W)	Army = 2,876	30	159	3,065
AGM-65 All Models (Maverick)	5,255		41	5,296

Notes:

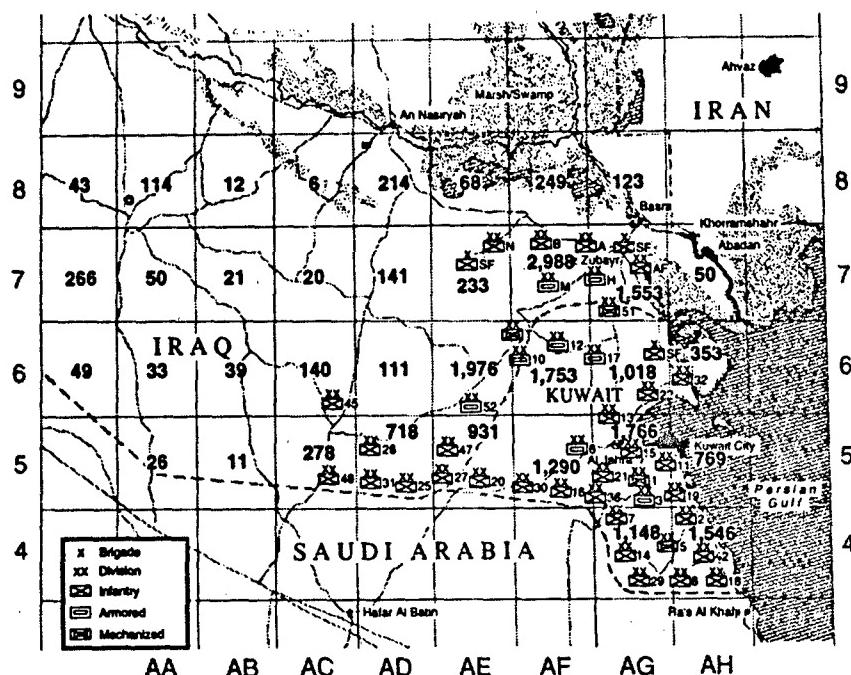
*The selected munitions were those most often employed in the Kuwait theater. Other types of laser-guided bombs and air-to-surface missiles were used in the war, but not, principally, in the Kuwait theater. Totals given are those employed on all targets, however, not just those in the Kuwait theater. See cited tables for a listing and totals of all weapons expended during the war.

**The Navy and Marine Corps also fired a total of 283 BGM-71 TOW munitions from helicopters.

⁸⁹Table derived from GWAPS *Statistical Compendium*, Tables 188, 189, 190, and 191; also Brfg, HQ DA, ODCOPS, "Aviation Division, Apache in Desert Storm," nd, enclosed in a folder, Army Aviation in Desert Shield/Storm (US Army Aviation Center, FTR, AL: 1992), GWAPS, NA 337. Munitions shown are the principal ones used in the Kuwait theater (some, but not many, of these weapons types were used elsewhere in Iraq). Totals are for the war overall, however, not just those expended in the Kuwaiti theater.

Note the highest totals are for those kill boxes containing the heavy divisions of the Republican Guard and other nearby heavy divisions in central Kuwait (AF7, AE6, and AF6).

Figure 25
Strikes Targeted by Kill Box, 17 Jan-28 Feb 1991



Several adjustments in tactics and munitions took place before Iraqi equipment attrition began to rise at a satisfactory rate. Those adjustments included an increased number of sorties to the Kuwait theater,⁹⁰ CENTAF's direction that the F-16s and A-10s lower attack and release altitudes, and increased proficiency of the crews as they gained experience. A sharp increase in the destruction of Iraqi equipment also occurred at the end of January during the battle of Al Khafji, when the Iraqi armored vehicles left their revetments and moved on roads.⁹¹ By far the

⁹⁰(S) Text of CENTCOM brfg, 26 Jan 1991, GWAPS, CHST 28; Gen Horner Comments, 26 Jan 1991, GWAPS, CHP 13-B.

⁹¹This battle is discussed later in the chapter.

greatest impact on Iraqi equipment attrition, however, was rendered by employing laser-guided bombs on Iraqi armor, beginning on 6 February and continuing for the duration of the war. These changes increased the rate of Iraqi armor and artillery attrition, but the fifty percent goal for the theater was not attained throughout the entire theater before the ground war began.

The amount of equipment attrition suffered by the Iraqi Army before the ground war was a highly contentious issue at the time, and postwar reconstructions can only partially update these wartime estimates. On the eve of the ground war, Central Command estimated that there had been thirty-nine percent attrition of Iraqi tanks, thirty-two percent of armored personnel carriers, and forty-seven percent of artillery.⁹² At the same time, the Central Intelligence Agency and Defense Intelligence Agency held to far lower estimates, differences that caused controversy between the theater and Washington.⁹³ By that time, however, General Schwarzkopf and his staff had rethought the practice of tying Iraqi unit effectiveness directly to equipment attrition. General Schwarzkopf refused to allow briefings that focused on specific percentages of equipment attrition, opting instead for a more subjective assessment of Iraqi unit capability with equipment attrition as only one of the variables. By this system, on the eve of the ground war, Central Command estimated the frontline Iraqi divisions to be below fifty percent effectiveness and the rear divisions, in general, at approximately seventy-five percent effectiveness.⁹⁴

Since the war, several additional sources of additional information have become available: photography of the *entire* theater at the beginning and end of the campaign (15 January and 1 March 1991), photography of *portions* of the theater during the air war, *partial* battlefield studies of Iraqi equipment, and reports on individual divisions from Iraqi prisoners of war.⁹⁵ These sources permit the following general assessments:

⁹²(S) USCINCCENT Situation Rpt, dtd 232115Z Feb 1991, GWAPS, CSS 29.

⁹³See Chapter 4 in this report for a discussion of these differences.

⁹⁴*Conduct of the Persian Gulf War*, p 256.

⁹⁵(S) Memo, Lt Col Allan W. Howey, USAF, subj: Tank Kills in the KTO, 26 Feb 1992, GWAPS, NA 167; (S) Memo and viewgraphs, Foreign Science and Technology Center, "Joint Intelligence Survey Team Rpt," 14 Jan 1992, GWAPS, NA 167; (S) U.S. Marine Corps Research Center, "Armor/Antiarmor Operations in Southwest Asia," Research Paper #92-0002, USMC, Quantico VA, Jul 1991.

- The Iraqi Army had approximately 800 fewer tanks and 600 fewer artillery pieces at the beginning of the air war than originally thought—approximately twenty percent fewer.
- Prior to the ground war, the Republican Guard heavy divisions⁹⁶ had suffered approximately twenty-four percent armor attrition, at a time when Central Command estimated thirty-four percent attrition.
- Prisoner-of-war reports indicate great variations in unit armor attrition during the air war, from ten percent for an armored division in the middle of the theater (12th Armored) to nearly one hundred percent for divisions close to the front lines (52 Armored, 25th, 30th, and 48th Infantry Divisions). Prisoners citing less attrition usually attributed the differences to protective berms, since those same units suffered substantially higher attrition of trucks that were not so protected.
- By the end of the war, the Iraqi Army had suffered approximately seventy-six percent attrition in tanks, fifty-five percent in armored personnel carriers, and ninety percent in artillery. The Republican Guard heavy divisions, however, had suffered only about fifty percent attrition in these same categories.
- Battlefield studies groups have had access to only a total of 163 tanks (6 percent of the 2,633 that had been destroyed or abandoned). Of this sample, between 10 and 20 percent had been hit by air-delivered munitions and about half (78 of 163) were not hit by munitions at all.

The data support several conclusions. First, Central Command's initial counts of equipment destroyed were inflated, but so too was the target base, and the errors are offsetting. In other words, Central Command's *percentages* of equipment destroyed by the beginning of the ground war were in line with later observations, though the *numbers* of pieces destroyed was inflated. Second, equipment attrition did not occur evenly throughout the theater but varied from high attrition to lower attrition by

⁹⁶A heavy division being an armored or mechanized division. The Republican Guard had a total of three in the theater: the Tawakalna (mechanized), Madinah, and Hammurabi (both armored).

division, moving south to north and from west to east in the theater. Highest attrition took place in the western frontline divisions; lowest in the divisions in the northeast corner of the theater.⁹⁷

A related issue to Iraqi attrition of equipment is their loss of personnel during the air war. Central Command produced no estimates of Iraqi personnel losses during or after the war, nor did the 1991 Department of Defense *Conduct of the Persian Gulf War*. Iraq itself has given estimates on number of Iraqi noncombatants killed but has not addressed its military losses. The reports that addressed the number of soldiers in each unit that were killed, wounded, or had deserted during the air war enable some estimates of the size of the Iraqi Army in the theater at the beginning of the ground war. Starting from a figure of 336,000, the estimated personnel manning the Iraqi Army at the beginning of the air war as described in Chapter 1, the Iraqi Army saw desertions of 25-30 percent. In addition, they suffered a smaller number of casualties to the air attacks—probably less than 10 percent of the force. As a result, the remaining strength of the Iraqi Army by 24 February numbered approximately 200,000 to 222,000.

The air interdiction, the damage to the communications and supply systems, along with the equipment attrition during the air war, clearly affected the Iraqi soldiers beyond the inflicting of casualties during that period. The Iraqi soldier, by and large, lost his determination to fight. The Iraqis did not defect or surrender in droves during the air and ground war because their armor and artillery were being destroyed (in fact, statements by Iraqi prisoners of war indicate they appreciated the discrimination of the air forces in aiming at the equipment and not them), but because many were short of food and water. The true effects of these attacks, in other words, came not from specific targets destroyed but from the combination of targets attacked and the intensity with which the attacks took place.

The pervasive impression left by the interrogation reports of prisoners was the sense of futility felt by the Iraqis after weeks of extensive bombing.⁹⁸ When the bombing started, their ground transportation began to

⁹⁷Lower equipment attrition in the east would coincide with the far lower rate of employment of precision munitions by the Marine Corps and Navy aircraft used in that area.

⁹⁸The following paragraphs draw on multiple prisoner of war reports.

crumble. Many, particularly the frontline forces, ran short of water, food, fuel, and all spare parts. Some units had their supply stocks destroyed. Training in the units ceased. Soldiers moved apart from their equipment because they well understood what the targets were. Many captured Iraqis stated they thought the air campaign would last several days to a week at most. When it did not end, the sense of futility and inevitability of the outcome became more apparent. During the course of the air war, many Iraqi soldiers, particularly those in the front lines, decided not to fight. Many deserted and others remained in place, but the effect on the capability of the Iraqi units was the same. The deserters from the front-line divisions told their interrogators that most of those remaining in their units would surrender at the first opportunity without any resistance. And this is what happened.

The ground offensive ended quickly, but there may well have been units qualified to fight and willing to resist. Few of those units were in the front lines, however. When the soldiers and officers in these frontline units decided not to resist, any opportunity for an organized defense in the theater collapsed. The Iraqi strategy called for the operational and strategic reserves to move to resist the points of the Coalition ground attack, but these reserve forces were fooled not only by the direction of the attack but by how fast it was upon them; the utter collapse of the Iraqi front lines made any planned movements by the reserves irrelevant. The reserve forces were themselves under attack before they had a chance to maneuver or present an organized defense.

Air Power with Engaged Ground Forces

The effectiveness of air power in supporting engaged ground forces during Desert Storm is particularly difficult to assess because the support took place only during the one-hundred-hour ground war and briefly during the Iraqi incursion into the Saudi town of Al Khafji. The brief time involved and the conditions under which the engagements took place—against thoroughly demoralized Iraqi troops, many in full flight or surrendering even before being engaged—make any generalizations based on these circumstances questionable. Moreover, the speed of the ground action added to the difficulty of making a precise accounting of specific actions that took place. After the war, no theater-wide survey was undertaken, although various organizations attempted reconstructions of some of the battlefield engagements.

Even the limited data make clear, however, that Iraqi forces were significantly more vulnerable on the move, day or night, than they were dug in and surrounded by air defenses. The Joint Surveillance Target Attack Radar System (JSTARS) aircraft, a test aircraft brought to the theater just before the air war, proved enormously capable of identifying the path of attacking or retreating columns of Iraqi equipment and provided both battlefield intelligence and targeting information. Moreover, vehicles out of revetments and on the move were vulnerable to more weapons, such as aircraft cannon fire and air-delivered mines. It is not surprising, then, that the success of attacks on moving columns of armor was substantially greater than those attacks on similar forces protected by berms, camouflage, and other defensive and deceptive measures.

From 29 through 31 January, the time of the Al Khafji battle, Iraqi ground movements were a subject of much conjecture. While there was detection of Iraqi forces moving south in eastern Kuwait, CENTCOM suspected that the move was a feint for a larger maneuver to the west, at the triborder area, by perhaps the Republican Guard divisions.⁹⁹ This suspicion was helped along by pilot reports that the Tawakalna Division had moved from its previous position (and was unlocated) and that the Madinah Division was observed moving south.¹⁰⁰ In this situation, the JSTARS capabilities took on tremendous value, to both evaluate the amount and nature of movement throughout the theater and track the specific movements of Iraqi forces in southeast Kuwait.

All indications are that the air attacks on the Iraqi Army during the Al Khafji incursion had a devastating effect. Iraqi equipment attrition as recorded by Central Command increased fourfold for the period 29 January to 3 February over what it had been for the entire air campaign up to that point. Even allowing for overcounting of the losses, the impact on the Iraqis was tremendous. While a number of prisoner of war reports mention the effects, the most telling one was the comment by a veteran of the Iran-Iraq War, who remarked that his brigade underwent more damage in thirty minutes than it had in eight years in the previous war.

⁹⁹(S) TACC Log, intelligence brfg on 28 and 29 Jan 1991, and a notation of a telephone call from the CENTCOM J-3, Maj Gen Moore, warning that the Al Khafji attack may have been a feint. GWAPS, microfilm roll 10263.

¹⁰⁰(S) CENTAF Historian Notes of TACC Operations, 29-31 Jan 1991, GWAPS, NA 200.

Subsequent to the experience at Al Khafji, the Iraq Army attempted no other attacks. They constructed more berms, dug deeper, dispersed supplies, changed to the use of smaller convoys in the Kuwait theater, moved headquarters locations frequently, and increased the use of decoys in many areas.¹⁰¹ Perhaps the greatest theater-wide impact of Al Khafji was its effect on the Iraq Army commanders. Their forces dug in to survive, but they had realized that counterattack or withdrawal "was impossible under the gun of the furious Coalition attacks." The Iraqis discarded their plans for major operations in the Kuwait theater as a result of this experience. Al Khafji was a major effort by Iraq to begin a ground war, the only such attempt Iraq made—hence, the importance of its failure. Iraq's only hope was to force an early start to a ground war of attrition before it was itself exhausted. At Al Khafji, air power had gained an important victory not fully appreciated at the time.

The lack of determined Iraqi resistance during the ground offensive made close air support by aircraft a peripheral aspect of this war. All the frontline Iraqi divisions crumbled quickly, often with no resistance at all, and as the corps advanced, they reported only light resistance throughout the theater. With the exception of isolated instances of determined resistance, possibly two in the Marine area of operations and several more in clashes by Army forces with units of the Republican Guards, rarely was the opposition not handled easily by Army or Marine ground weapons alone.¹⁰² There were, in other words, few situations of "troops in contact" to test how well close air fire support by U.S. Marine Corps fixed-wing aircraft or attack helicopters could be synchronized with ground fire support systems. As early as the first morning, forward air controllers turned aircraft back to the Tactical Air Control Center as unnecessary, and many aircraft returned with their ordnance because they could not be employed anywhere else. The primary close air support aircraft, A-10s and AV-8Bs, saw much less action than planned: A-10s reported 316 of 909 sorties (35%) ineffective (that is, they did not drop their bombs), and AV-8Bs had more total missions canceled or with no drops (143) than

¹⁰¹(S) USCINCCENT/J2 Msg, Collateral Intelligence Report No. 180, 6 Feb 1991, GWAPS, CHST 42.

¹⁰²A possible exception would be the employment of aircraft (F-16s in one case, A-10s in another) to assist in the protection and extraction of special forces personnel operating behind enemy lines.

they had successful missions (131).¹⁰³ Even some of the B-52 sorties scheduled for bombing the breach sites were redirected in flight to other targets because the ground advance had already passed beyond the sites.¹⁰⁴

Close air support supported the ground attack but was not considered vital to the attack's success. Because of the nature of the enemy resistance, or the lack of it, there were few instances in which close air support sorties had to drop munitions close to Coalition ground forces to stop an Iraqi attack. The aircraft employed were capable of much more than was requested from them, but Coalition artillery and rocket launchers, the superior range of Coalition tank guns and other direct fire weapons, and the tremendous advantage of thermal imaging sights that allowed M1A1 tanks to engage Iraqi tanks at ranges nearly double the maximum acquisition range of the Iraqis, allowed the Coalition ground forces to handle those few instances of resistance without substantial assistance from the air. Air power's greater effectiveness was in attacking the forces deeper in the Iraqi defense areas, in the regions where these attacks blended in with the interdiction strikes.

During the ground offensive, Coalition helicopter operations provided great mobility and airborne firepower. Although Army AH-64 Apaches helped destroy Iraqi air defense installations on the first night of the air campaign, there was only a limited amount of helicopter employment in cross-border operations in order to preserve these aircraft for use with the advancing ground forces. Once the ground advance began, helicopters moved logistics support rapidly and repositioned the ground forces themselves. On the first day of the ground offensive, helicopters of the U.S. 101st Airborne Division conducted the largest heliborne operation ever staged by moving a brigade of the 101st to a base 93 miles into Iraq and then reaching that far again to cut Highway 8, the Iraqi army's only possible line of retreat west from the theater.¹⁰⁵

¹⁰³(S) *Marine Corps Reconstruction Report*, Vol. IV, p 77; (S) Combat Chronology 23/354 TFW(P), entries for 24 - 28 Feb 1991, GWAPS, Microfilm Roll 26557. A-10 data are for all sorties; only partial data are available for close air support sorties, but those data indicate the unsuccessful rate was even higher for these sorties.

¹⁰⁴(S) *History of the Strategic Air Command, 1 Jan-31 Dec 1990, Vol I* (Hq, SAC History Office, 1992), p 273.

¹⁰⁵*Conduct of the Persian Gulf War*, pp 261-62.

Coalition attack helicopters saw action both in direct support of the attacking Coalition ground forces and in conducting independent, deep attacks behind Iraqi frontline forces, the latter attacks, conducted principally by helicopter units of the XVIII Corps.¹⁰⁶ In several instances, because of low ceilings due to weather, blowing sand, or oil well fires, only helicopters could operate successfully. Several deep operations (50 miles or more) by the AH-64s that accounted for significant destruction of Iraqi equipment took place in the final two days of the war.¹⁰⁷ A limitation for these deep sweeps proved to be the logistics and planning required to support operations, particularly with the ground forces moving so swiftly. As a result, the first such deep raid did not take place until late on 26 February, with three more multibattalion attacks taking place during the day and evening of February twenty-seventh. The largest raid on 27 February was conducted by AH-64s on the causeway crossing the Hawr al Hammar, a key exit route from the theater (to be discussed later); during the raid, the Apaches disabled many vehicles caught in the congestion waiting to cross the causeway.¹⁰⁸

Air interdiction operations during the ground offensive were conducted in two phases. During the first phase, from the initiation of the offensive to the evening of 25 February, aircraft attacked the reserve heavy divisions (and the other Republican Guards divisions as well) in order to destroy their capability to move or maneuver against the Coalition ground forces. The second phase began after intelligence information indicated (and airborne aircraft had confirmed) that a general retreat of Iraqi forces was underway (evening of 25 February). From that time until the cease-

¹⁰⁶ Attack helicopters employed were the Army's AH-64, Marine Corps AH-1W, the French Army Gazelle, and the British Army Lynx. The Kuwait Air Force also possessed Gazelle helicopters, but they were not employed as attack aircraft during Desert Storm. The Army had AH-1s deployed to the theater, but there is no record of their employment as attack helicopters.

¹⁰⁷ Hq DA, ODCOPS, Aviation Division, "Apache in Desert Storm," nd (hereafter referred to as "Apache in Desert Storm"), enclosed in a folder, *Army Aviation in Desert Shield/Desert Storm* (U.S. Army Aviation Center, Ft Rucker, AL, 1992), GWAPS, NA 337, p34; (S) *Marine Corps Desert Storm Reconstruction Report, Vol IV*, p 113.

¹⁰⁸ *Army Aviation*, pp 86-108; "Apache in Desert Storm"; 8th Air Support Operations Group After Action Review, Operations Desert Shield/Storm, nd, GWAPS, NA 577.

fire at 8:00 a.m. local time on 28 February, the focus of air interdiction became one of pursuing and destroying the retreating army.¹⁰⁹

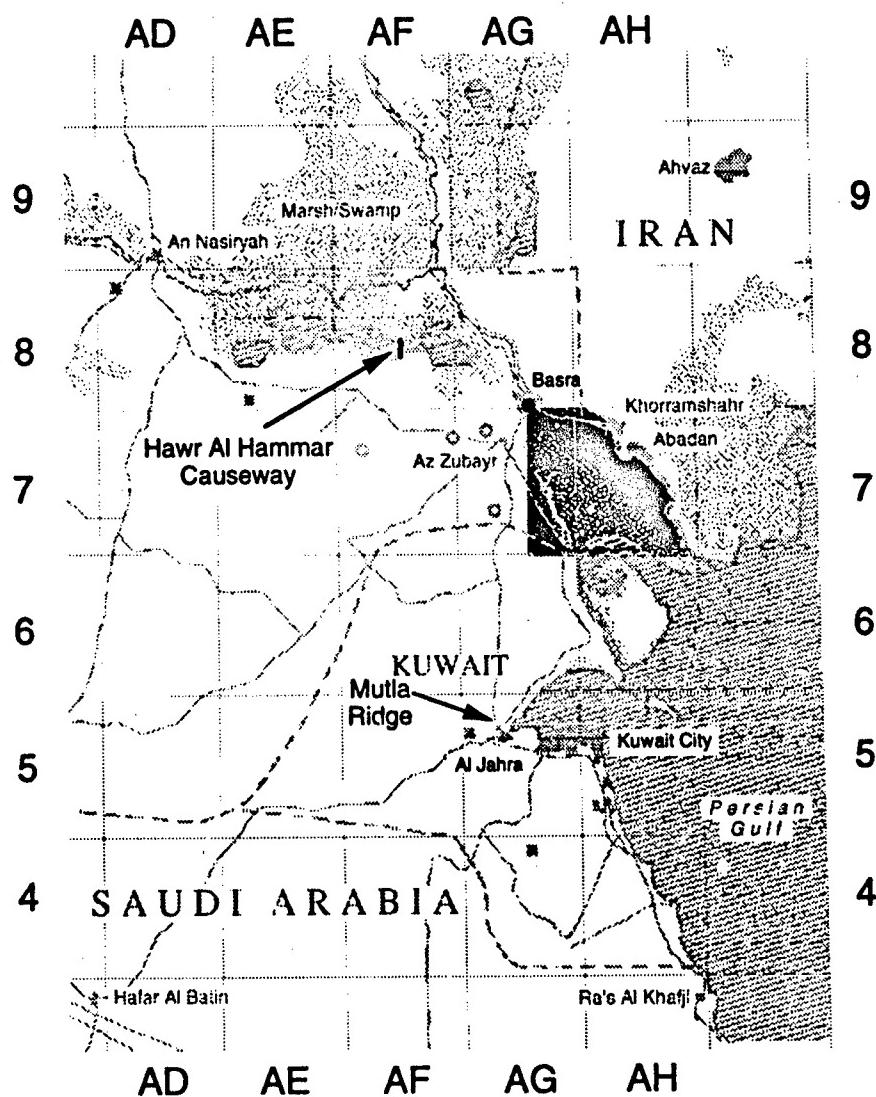
For the first two days of the ground offensive, air interdiction strikes took place on Iraqi troop concentrations and equipment just beyond the fire support coordination line (the line behind which air attacks require approval and coordination of the ground commander). Other aircraft prowled the deeper areas of the theater, often at night, receiving cues from JSTARS aircraft or control/scout aircraft (F-16 Pointer or F/A-18D) to attack any movement of forces. After the general retreat of the Iraqi forces on the evening of 25 February, the interdiction sorties bore down on the retreating columns of Iraqi forces flowing north in trucks, cars, boats, and any other means available to depart the country. The units in the northern part of the theater had the best chance of escaping intact. The forces that followed them, however, slowed and then stopped at points where many units converged .. bridges or roadway chokepoints.

Mutla Ridge, the high ground to the west of Kuwait City and just north of the city of Al Jahra, was the first place air strikes stopped the retreating columns. The major road to Basra passing over the bluffs of the ridge became a natural chokepoint for the traffic retreating from throughout southeast Kuwait. This traffic became combined with that fleeing Kuwait City (see Figure 26). Once air attacks halted the forward elements of this traffic, the remaining several miles of vehicles were attacked throughout the evening, leaving a scene of abandoned and burning vehicles approximately two miles long. The news media identified this scene as the "highway of death" in the immediate aftermath of the war.¹¹⁰ A count of destroyed vehicles, made from photos taken on 1 March, put the number at more than 1,400, which included only 14 tanks and 14 other armored vehicles. Reporters found somewhere between 200 and 300 dead Iraqis at the scene; the other occupants presumably either escaped north or became prisoners.

¹⁰⁹ No phases were either planned or announced, of course. The term phases is used simply to describe the unfolding events. Word of the general withdrawal came from Iraqi army radio intercepts, communications from the Kuwait resistance in Kuwait City, and aircraft in the region. (S) TACC Log, entries of 25 Feb, 1991, GWAPS, NA 215.

¹¹⁰ Steve Coll and William Branigan, "U.S. Scrabbled to Shape View of 'Highway of Death,'" *Washington Post*, 11 Mar 1991, p 1.

Figure 26
Chokepoints for Retreating Iraqi Troops in the Kuwait Theater
(Shaded area depicts no-strike areas declared on 27 Feb)



A second choke point for the retreating Iraqi forces occurred at the causeway over the Hawr al Hammar, the large lake and marshlands northwest of Basra. The multilane causeway had been bombed and repaired several times during the war and could sustain only limited traffic. Aircraft, principally F-111Fs, destroyed enough vehicles to block the traffic on the evening of 26 February, and aircraft strikes continued the following day, most notably a deep attack by AH-64s. Aerial photography 2 days later showed approximately 550 to 600 vehicles abandoned at the location; as at Mutla Ridge, only 10 to 20 of these were armored vehicles.¹¹¹

The final chokepoint for traffic out of the Kuwait theater was at the city of Basra. Here, in the final day of the war, with Coalition ground forces moving in from the west and cutting off all escape in that direction, the fleeing Iraqi forces attempted to get through the city and its canals and across the river to the east, the last remaining exit. With all bridges over the canal and river either damaged or destroyed, traffic stopped at the canal on the western side of the city. The backup stretched approximately twenty miles to the west. Into this congestion, the remnant of the Iraqi Army, including the remaining Republican Guard divisions, had retreated.

No scenes of destruction such as seen at Mutla Ridge or the Hawr al Hammar took place in Basra or at the canal, however, because of conditions that affected the bombing. First, the area west of Basra was not open desert but a more built-up area of farms and small towns. Iraqi tanks and other military vehicles took advantage of this situation by parking on neighborhood streets and generally mixing in with civilian buildings in the area.¹¹² Second, the low weather ceiling in that area, the proximity of the Coalition ground forces on 27 February, and the closeness of the target area to Iranian territory all restricted bombing operations.¹¹³ And finally, the war was ending; at 8:00 a.m. the next morning, 28 February, the cease-fire took effect, sparing the Iraqi force from further Coalition air and ground attacks.

¹¹¹(S) *Army Aviation* pp 86-108; GWAPS Missions Database, sorties of 26/27 Feb 1991; and brfg. CIA-OIA to GWAPS, 25 Jun 1992.

¹¹²(S) Brfg. CIA-OIA to GWAPS, 25 Jun 1992.

¹¹³(S) CENTAF Historian, "TSgt Barton's Notes from TACC," 25/1020 Feb 1991, GWAPS, NA 200; (S) TACC Log, entries of 27 Feb 1991, GWAPS, NA 215; and Airborne Battlefield Command and Control Center LOG, entries of 27 Feb 1992, GWAPS NA 287.

Air power had two important effects on the Iraqi army during the four days of the ground war—one imposed during those four final days, the other imposed during the preceding weeks of the campaign. Air strikes during the air war had made the Iraqi forces in some cases unwilling and in other cases unable to maneuver or mount an effective defense. Lack of communications, equipment attrition, and destruction of the theater distribution system had combined to bring about these conditions. The rout of maneuvering Iraqi forces during the engagement at Al Khafji gave those forces a preview of what was in store. During the ground war, concentrated attacks on the Iraqi heavy divisions prevented them from playing any other role than self-defense, and several of these divisions did not even do that. In some instances involving frontline Iraqi divisions, air power had merely to show up to prompt the forces to surrender.¹¹⁴

Estimates of air power's worth during the ground war must look beyond the last four days themselves. The most important contribution of air power in the Kuwait theater during the ground war, and a prime reason why the ground campaign was so short and so overwhelming, was the success of air interdiction in preventing the heavy divisions from moving or fighting effectively. Those several days of air interdiction did not have that result—the interdiction sorties after 23 February were just a continuation of the campaign that began on 17 January. Nor were the interdiction sorties dissimilar from the close air support sorties flown; interdiction and close air support sorties often occurred just a few miles apart. What the events on the ground made clear is that air power essentially paralyzed or demoralized the Iraqi heavy divisions on which the Iraqi strategy depended. The remnants of some divisions were destroyed in place or surrendered with little resistance; others fled the theater without much of their equipment, while those closer to the border were able to make a more orderly departure. Those left with a will to fight were able to do little more than face the attack and return fire, with no hope of maneuvering, or being reinforced, or achieving even tactical success. The engagements of the Marines with elements of the Iraqi 3d Armored Division at Kuwait International Airport on 26 February and of VII Corps with elements of the Tawakalna, 12th, and Madinah Divisions on 26 and 27 February were just such desperate actions.

¹¹⁴"Soon as air showed up, Iraqis started surrendering." (S) TACC Log entry for 25 Feb, recording comments passed by members of 1st Infantry Division, GWAPS, microfilm roll 10263.

Ironically, the loss of equipment, a key index of bomb damage assessment used during the war, was not decisive in any direct way. The Iraqi army did not run out of tanks, armored personnel carriers, or artillery; in fact, much of the equipment remaining intact at the start of the ground offensive was abandoned, or was at least unoccupied, when the Coalition ground forces reached it. Reports of AH-64 strikes describing the attacks on armor columns noted that when firing began on the first tank, the crews of the other tanks began abandoning their vehicles.¹¹⁵ The total number and operability of the tanks had less meaning under those conditions.

Air power had destroyed not only large amounts of equipment. It had destroyed the confidence of the Iraqi soldiers that the equipment would do them any good—on the contrary, the equipment was seen as a magnet for air strikes. Whether or for how long the Iraqi troops could have held on and for how long, even without a ground attack, are matters for speculation. The demonstrable fact is that the Iraqis simply could not react once the ground attack took place and Coalition forces swept through the theater. This Survey could not assess possible differences in Iraqi resistance if the Coalition ground forces had less air support or had there been a shorter air campaign. The survey did determine, however, that air power made that resistance disorganized and totally ineffective.

Summary

Table 4 lists the Iraqi target sets and conclusions, in abbreviated form, reached by the Survey regarding the operational-strategic effectiveness of Coalition air power. For brevity, the table omits much, and the reader should not overlook the subtleties and reinforcing aspects of the air campaign that such condensations inevitably submerge. Although some of the results in the summary table contain quantitative data, the numbers are intertwined with qualitative judgments providing a needed context. As noted throughout this chapter, the Survey found few cases in which quantitative measures alone were sufficient to tell more than a part of the broader operational-strategic story.

¹¹⁵Comment by the XVIII Airborne Corps Aviation Officer, *Army Aviation*, p 153.

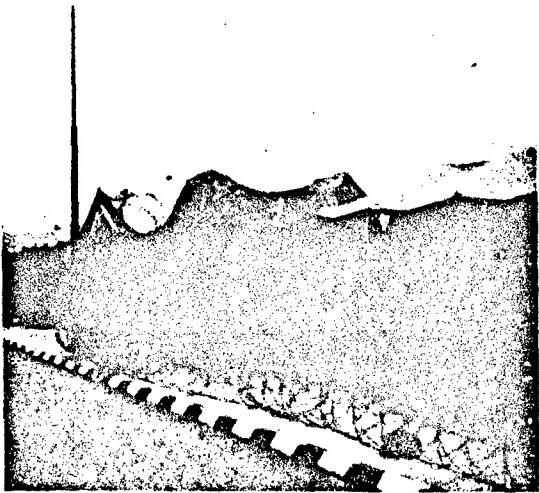
Table 4
Operational-Strategic Summary

Target Sets*	Desired/Planned Effects	Actual Results
IADS (SAD) & Airfields (A)	Early air superiority <ul style="list-style-type: none"> • Suppression medium-high air defenses throughout Iraq • Contain/destroy Iraqi AF 	IADS blinded/ intimidated/suppressed <ul style="list-style-type: none"> • Low-altitude AAA, IR SAMs remained Iraqi AF bottled up on bases <ul style="list-style-type: none"> • 2 air-to-surface Iraqi shooter sorties? 375 of 594 HABs destroyed/damaged <ul style="list-style-type: none"> • Iraqi AF flees to Iran (starting 25 Jan 91)
Naval (N)	Attain sea control <ul style="list-style-type: none"> • Permit naval operations in northern Persian Gulf 	All Iraqi naval combatants sunk/neutralized <ul style="list-style-type: none"> • Other vessels sunk Silkworms remained active throughout war
Leadership (L) & Telecomms/C3 (CCC)	Pressure/disrupt governmental functioning Isolate Saddam from Iraqi people, forces in KTO	Unknown degree of disruption <ul style="list-style-type: none"> • Neither decapitation nor Saddam's overthrow Telecomms substantially reduced <ul style="list-style-type: none"> • Links to KTO never completely cut • International communications cut
Electricity (E) & Oil (O)	Shut down national grid <ul style="list-style-type: none"> • Minimize long-term damage Cut flow of fuels/lubricants to Iraqi forces <ul style="list-style-type: none"> • No lasting damage to oil production 	Rapid shutdown of grid <ul style="list-style-type: none"> • Down 55% by 17 Jan, 88% by 9 Feb • Lights out in Baghdad Some unintended damage to generators Refining capability down 93% (Day 34) Destroyed about 20% of the fuel/lubricants at refineries & major depots <ul style="list-style-type: none"> • 43 day war precluded long-term effects

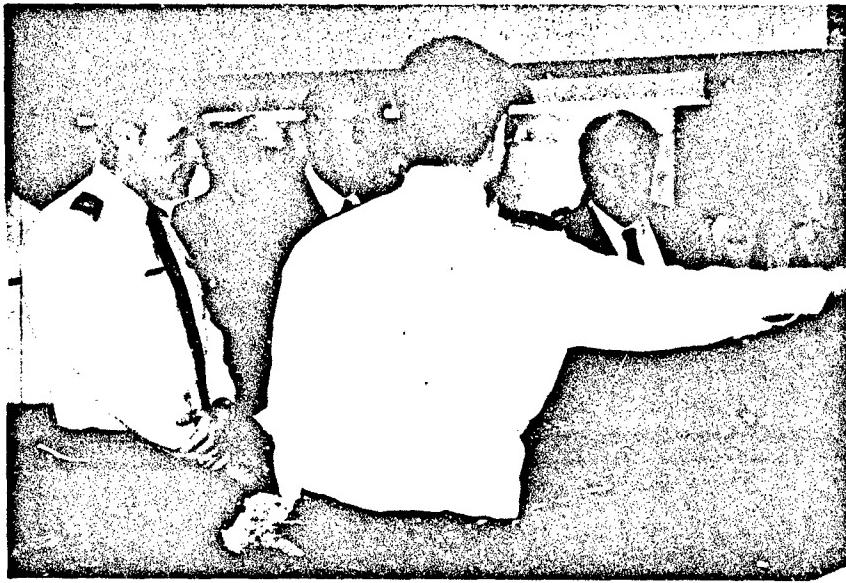
Table 4 (Continued)
Operational-Strategic Summary

Target Sets*	Desired/Planned Effects	Actual Results
NBC (C) &	Destroy chem/bio weapons • Prevent use against Coalition • Destroy production capability	Some chemical weapons destroyed • But most survived (UN Special Comm) • Chemical use deterred • No biological weapons found (UN)
	Destroy nuclear program • Long term	Nuclear program "inconvenienced" (UN) • Most program elements survived
SCUDs (SC)	Prevent/suppress use • Destroy production & infrastructure • Keep Israel out of the war	Firings somewhat suppressed, not salvos • SCUD operations pressured • Aircraft destroyed few, if any, MELs/TELs
Railroads/Bridges (RR)	Cut supply lines to KTO • Prevent retreat of Iraqi forces	All important bridges destroyed • Many Iraqi workarounds Short duration of war limited effects
Republican Guard (RG) & Other Ground Forces in the KTO	Destroy the RG Reduce combat effectiveness 50% (armor, artillery) by G-Day	RG immobilized • Attrition by G-Day <50% • Some RG units and 800+ tanks escape Front-line forces waiting to surrender or destroyed in place • Attrition by G-Day >50% • Morale destroyed by air

*Military support (MS), Breaching targets (BR), and KTO SAMs are subsumed in the target categories shown.



(Above) CENTAF Intelligence (CENTAF-IN) facility, set up on the U.S. Military Training Mission Compound, adjacent to, but several hundred yards from, the Royal Saudi Air Force Headquarters (location of Gen Horner's headquarters and the Tactical Air Control Center), Riyadh, Saudi Arabia. (Photo courtesy of Lt Col Bruce Weigle, USAFR)
(Below) Col John Warden and staff brief Air Force Secretary Donald Rice and Secretary of Defense Dick Cheney in Checkmate offices, Pentagon, Feb 1991.



What was the Role of Intelligence?

Few issues from the Gulf War remain more controversial than the performance of American intelligence organizations. Participants have both damned and praised intelligence support of the war effort. In post-war testimony before Congress, Gen. H. Norman Schwarzkopf stated that while the "intelligence community as a whole did a great job," he felt that he, as a theater commander, was not well served.¹ His specific criticisms centered on national intelligence estimates so heavily caveated as to be "useless" to him in the field and on bomb damage assessments done in Washington that varied from those done in theater.² At the same time he wrote, "I was blessed with an intelligence staff whose work was so good that the military intelligence community in Washington usually let Central Command take the lead, seconding our assessments of developments in the Middle East."³

Part of the difficulty in judging the adequacy of intelligence during Desert Shield and Desert Storm lies in the range and complexity of functions it covers. Another part of the difficulty undoubtedly stems from the uncertainties endemic to intelligence functions such as targeting and bomb damage assessment—uncertainties that are ultimately inherent in any use of military force to achieve political ends. This discussion surveys the various intelligence requirements in the Gulf War and how well they were satisfied, the accuracy and timeliness of information, the variety of purposes served by intelligence and intelligence organizations

¹U.S. Congress, House, Committee on Appropriations, *Department of Defense Appropriations for 1992*, Hearings before the Subcommittee on the Department of Defense (Washington, DC: Government Printing Office, 1991), Part 2, pp 288 and 290.

²Michael Wines, "Gulf Intelligence Draws Complaint by Schwarzkopf," *The New York Times International*, 13 Jun 1991, pp A1 and A7.

³Gen H. Norman Schwarzkopf, *It Doesn't Take a Hero*, written with Peter Petre (New York: Bantam Books, 1992), pp 293, 430-32, hereafter cited as *Hero*.

at various levels, the relations between producers and consumers of intelligence, and the expectations, realistic or otherwise, that commanders and staffs had of intelligence.

Dealing with the role of intelligence in an unclassified format so soon after the events themselves placed limits on what could be discussed here. Many details could not be mentioned, and major pieces of the story such as the roles played by human and signals intelligence in the Gulf War had to be omitted entirely. This chapter should be read with those constraints in mind. At most, it represents a start in understanding the capacities and functions of intelligence in the war.

Estimates

Estimates of Iraq's military capabilities and intentions were not central concerns of the United States until the spring of 1990. A 1989 national intelligence estimate had assessed Iraq as not likely to invade Kuwait, and U.S. intelligence was only beginning to shift its resources from a focus on the Soviet Union. In the fall of 1989, Central Command had begun to orient its regional planning on Iraq, but information on Iraq's military forces, installations, communications, and leadership was far short of that necessary for effective targeting. Moreover, the aggressive security and counterintelligence policies of the Iraqi regime made attempts to collect such information even more difficult.⁴ Central Command's exercise Internal Look had accelerated the target development process, but an extensive effort was needed throughout Desert Shield and continued during Desert Storm to identify and assess the Iraqi target base. Even after the war, much was still unknown.

Before the war, the national intelligence agencies, along with the military services and fighting commands, maintained and updated their installation and order of battle databases as new information became available. Unfortunately, when Baghdad invaded Kuwait, the most comprehensive database—Defense Intelligence Agency's (DIA's) Automated Installations Intelligence File—was not current, caught in the post-Cold War transi-

⁴U.S. Department of Defense, *Conduct of the Persian Gulf War, Final Report to Congress*, Apr 1992, p 333.

tion from Soviet to regional threats. However, in preparation for Exercise Internal Look, work had begun to rectify this situation, and during the second half of 1990, considerable advances were made. Still, in many areas the intelligence was old and therefore either misleading or useless.

Iraq's deception efforts made the problem of updating information far worse, particularly in the case of its nuclear research program. The Iraqis successfully relocated, dispersed, and, in some cases, buried nuclear processing equipment to avoid attack.⁵ As a result of its hidden facilities and Baghdad's unorthodox procedures undertaken to preserve its nuclear capabilities, the Coalition's understanding of the Iraqi program remained slight. From August 1990 and extending through the beginning of the air campaign, the target list contained only two known and two suspected nuclear facilities; this increased to eight by the end of the war.⁶ After the war, International Atomic Energy Administration inspectors identified more than twenty sites involved in the Iraqi nuclear program, including some sixteen main facilities.⁷ These inspections revealed that the Iraqis had a far more extensive and dispersed program than Western intelligence had previously estimated. The intelligence community could not, of course, have produced a picture as comprehensive as the one United Nations Special Commission inspectors pieced together after recurring and intrusive on-site postwar visits. Nevertheless, certain first-order questions do not appear to have been asked, much less vigorously pursued, about the extent of active deception and concealment measures that Baghdad might take to complicate Coalition targeting.

In addition to protecting its nuclear program, Baghdad went to exceptional lengths to conceal the composition and operation of its Scud missile force. Unlike the case of the nuclear program, intelligence estimates correctly identified most Scud production and support facilities, which Coalition air forces subsequently bombed. Intelligence analysts, however,

⁵David Kay, "Arms Inspections in Iraq: Lessons for Arms Control," 12 Aug 1992, p 3, GWAPS, NA 375.

⁶(S) Master Target Lists, Master Target Folder, GWAPS, BH 53.

⁷Security Council Rpt, S/23215, Seventh IAEA on-site inspection, 11-22 Oct 1991, 14 Nov 1991, p 63.

never knew enough about Iraqi employment procedures to provide the cueing necessary to bring effective air power to bear on the mobile Scuds. Several intelligence teams examined the mobile Scud issue and relayed promising information to DIA and the theater.⁸ These teams were schooled in how the Soviets had operated Scuds in Warsaw Pact exercises and the infrared and radar signatures mobile Scud launchers would emit if employed according to previous Soviet practices. The DIA/J-2 intelligence team in particular created target materials illustrating how hard it would be for aircraft to acquire mobile launchers with onboard sensors—especially from medium altitude or higher.⁹ When war finally came, this inherent difficulty with target acquisition by fixed-wing aircraft operating at night from medium altitudes was further compounded by major Iraqi divergences from known Soviet practices. The Iraqis would arrive at a mobile launch site, set up within a few minutes, and, dispensing with many of the normal calibrations, launch and be on their way within about ten minutes.¹⁰

Although intelligence identified most, if not all, of the fixed launch sites, analysts could not find mobile launch or intermediate assembly or preparation sites, and so could not predict with any precision the locations from which Scuds might be launched. Moreover, the "Scud hunt" unfolded in a way that tended to mask this problem from intelligence analysts, strike planners, and commanders alike. The first ten days of the air campaign saw numerous claims of mobile Scud kills by aircrews, backed in some cases with cockpit video, and the lull in launches during the third and fourth weeks seemed, at first, to substantiate pilot reports. In retrospect, however, many of the Coalition aircraft had struck decoys, other shorter range missiles, or traffic such as fuel trucks. Intelligence had not understood the full scope of Baghdad's Scud decoy program and exploitation of "low signature" firing locations.

⁸(S/NF) Rpt, HQ USAF/IN, "Operation Desert Storm Lessons Learned," 5 May 1991, JULLS Number 41421-92977 (00018), pp 34-35; (S) Intvw, Lt Gen Charles A. Horner, transcript dtd 28 Jan 1992, GWAPS, NA 303.

⁹Intvw, GWAPS with Capt Edward O'Connell, 23 May 1992. O'Connell was in the DIA targeting branch during the war.

¹⁰*Conduct of the Persian Gulf War*, p 167; *Hero*, p 420.

Intelligence made much more accurate estimates of Iraqi army and air force dispositions and intentions. In the early fall, intelligence estimates correctly noted that the invading Iraqi force had transitioned to a defensive posture. Intelligence knew the locations and intentions of the less capable regular army units digging in near the Kuwaiti/Saudi Arabian border and the more capable Republican Guard being kept as a strategic reserve. By the end of 1990, the national intelligence community believed that Iraq would defend in place, try to force the Coalition (if it were to attack) into a war of attrition on the ground, and attempt to arrive at a stalemate that would undermine U.S. national will.¹¹

Of particular interest to air power planners was the appraisal of the Iraqi air force and its supporting air defenses; an October 1990 Central Intelligence Agency assessment correctly surmised that

The Iraqi Air Force would not be effective because it would either be neutralized quickly by Coalition air action or it would be withheld from action in hardened shelters. Within a few days, Iraqi air defenses would be limited to AAA [antiaircraft artillery] and hand-held and surviving light SAMs [surface-to-air missiles]. The AAA would present a significant threat to low-level air operations. . . .¹²

In the months to follow, other intelligence organizations addressed this issue. The Naval Intelligence Command's Strike Projection Evaluation and Anti-Air Warfare Research (SPEAR) group made a particularly accurate forecast. They held that the Iraqi air force would not put up a determined defense, relying instead on hit-and-run and dispersal tactics to enhance its survival. In addition, the naval analysts (a highly successful mix of operational and intelligence personnel) correctly foretold Baghdad's reliance on radar-guided surface-to-air missiles as the mainstay of its air defense and accurately assessed the strengths and weaknesses of its KARI integrated air defense system.¹³

¹¹(S/NF/NC/OC) CIA memo of Jan 1991.

¹²CIA assessment of Oct 1990.

¹³(S/NF/WN/NC) Doc, SPEAR, Naval Intelligence Command, *Iraqi Threat To U.S. Forces*, 10 Dec 1990, p 3-53.

The limited amount of [all-weather] fighters compared with Iraq's large number of strategic [radar-guided] SAMs . . . makes the SAM the logical choice as the primary air defense weapon . . . Iraq probably will not put up a determined, concentrated fighter defense, thus avoiding quick elimination of its interceptor force.¹⁴

SPEAR's assessment was distributed widely within the theater and briefed to aircrews before Desert Storm; it remains perhaps the best assessment of the Iraqi air force and air defense system.

Intelligence encountered greater difficulty in determining the number of Iraqi troops and equipment in the Kuwait theater. Although Coalition leaders knew the general disposition of Baghdad's forces in the theater before Desert Storm, they understood far less well the *actual* numbers of men and combat equipment in the Iraqi units. As a result, manning and equipment estimates rested on an assumed full manning. Intelligence attempted to verify that information by imagery. The resulting numbers, which proved to be a considerable overestimate of the actual Iraqi force in the theater, remained the basis for Coalition action against that force. Intelligence analysts and Coalition planners originally estimated that the Iraqis had about 540,000 troops in the Kuwait theater just before the air campaign, and about 450,000 when the ground offensive began.¹⁵ These same estimates put Iraqi equipment totals at nearly 4,300 tanks and slightly more than 3,100 artillery pieces in the Kuwait theater at the beginning of the air campaign,¹⁶ but the intelligence agencies and theater assessments differed widely on how much equipment remained at the beginning of the ground campaign.

Several factors complicated a more accurate assessment of the true strength of the Iraqi army. First, that army had undergone a reorganization after the Iran-Iraq War, changing the divisional manning and complicating

¹⁴*Ibid.*, pp 3-51 and 3-52; also Intvw, Cmdr Fitzgerald, SPEAR, with GWAPS, 15 May 1992.

¹⁵*Conduct of the Persian Gulf War*, p 254. Also see Chapters 1 and 3 in this report for the Survey's estimates of the strength and equipment totals of the Iraqi army at the beginning of the air campaign and the beginning of the ground offensive.

¹⁶*Conduct of the Persian Gulf War*, p 254.

the analysts' task of determining a unit's size and composition once the unit itself was identified. Second, the size of the Iraqi army in the Kuwait theater increased throughout the fall of 1990, just as the Coalition forces did, so any estimate of Iraqi strength was soon out of date. Third, the Iraqis made major efforts to thwart accurate preconflict estimates by Coalition intelligence agencies through extensive deception, such as constructing numerous unoccupied berms and deploying decoy tanks and artillery. And finally, indications of independent Iraqi brigades and of divisions with additional attached brigades compounded the process of identifying and properly classifying all the units in the theater. Because of these complicating factors, the estimates used figures for the Iraqi units at full strength in men and equipment. Later analysis would indicate that the less-than-full manning made the estimates too high by twenty to twenty-five percent.¹⁷

Enough information became available during the air campaign (primarily reports from Iraqi soldiers defecting into Saudi Arabia) to cast doubt on the original strength estimates, but those estimates remained unchanged. Defector reports numbered in the hundreds, but these Iraqi soldiers came almost entirely from the frontline infantry divisions and thus gave little indication of the status of heavy divisions in the rear.¹⁸ Furthermore, the U.S. military command structure refused to comment on or engage in assessments of Iraqi personnel strength, or losses, either during or after the war. Generals Powell and Schwarzkopf, made wary of body counts by their experiences in the Vietnam War, chose what they thought a more important estimate—the numbers of maneuver divisions and brigades.¹⁹

The overestimate of the Iraqi equipment totals induced an unintended consequence in theater targeting. Central Command carefully considered

¹⁷Analyses of Iraqi personnel and equipment strengths at the beginning of the air campaign, beginning of the ground offensive, and the end of the war, are examined in Chapters 1 and 3 of this report.

¹⁸While the Survey estimates there were well over 100,000 Iraqi deserters, the bulk of these returned to Iraq, not across the line into Saudi Arabia.

¹⁹CENTCOM News Brfg of Gen H. Norman Schwarzkopf, Riyadh, Saudi Arabia, 27 Feb 1991; (TS) Intvw, Mr. Ron Cole, JCS/Historical Staff, and Ms. Diane Putney, Office of Air Force History, with Rear Admiral J.M. McConnell, USN, Deputy Director for Intelligence, Joint Staff, 14 Feb 1992, GWAPS, NA 261.

equipment totals and made them serve as a basis for assessing Phase III of the campaign, preparation of the battlefield. Leaders measured their success in terms of *percentages* of equipment destroyed. Considering that postwar analysis credits the Iraqis with 800 fewer tanks than originally estimated, this meant that attaining 50 percent attrition of the *estimated* number of tanks would have brought approximately 62 percent attrition to the *actual* number of tanks. However, just as much uncertainty applies to the amount of equipment *actually* destroyed, thereby offsetting the errors.

Organizational Relationships

Various planning documents written before the war outlined the organizational relationships that would exist between intelligence analysts, targeteers, and operations planners.²⁰ Those that developed during Desert Shield and Desert Storm differed considerably from what had been envisioned. At the outset, neither Central Command's intelligence nor that of the air component of Central Command (CENTAF) staff had adequate manpower to support an air war of Desert Storm's scope.²¹ The plan had always been that skeleton staffs of these organizations would gain augmentees from other organizations during mobilization. The CENTAF intelligence staff was formed from the 9th Tactical Intelligence Squadron and consisted of only 8 personnel, 6 of whom were not fully qualified.²² Although these personnel participated in the Central Command Commander-in-Chief's Exercise Internal Lock, which concluded only days before the Iraqi invasion, the exercise was not designed to test intelligence analysis and dissemination. During the Desert Shield buildup, national and Service intelligence organizations did send a limited number of qualified specialists to various intelligence organizations in the theater. However, of the some 180 active-duty, fully trained, target-intelligence personnel available throughout the U.S. Air Force, only 40 were deployed

²⁰USCINCCENT OPLAN 1001-90 (Second Draft), 18 Jul 1990, Annex 7 to Annex B.

²¹*Conduct of the Persian Gulf War*, Appendix C, p 337; and (S/NF) Rpt, HQ USAF/IN, "Operation Desert Storm Lessons Learned," 5 May 1991, JULLS Number 41960-26699 (00031), p 64, GWAPS, NA 136.

²²Intvw, Lt Col Kistler, Mark Mandeles, and Maj Terry with Capt John Glock, USAF, Langley AFB, VA, 30 Jan 1992.

to the theater, and, of the active-duty personnel with any target intelligence training, less than 18 percent were deployed.²³ The bulk of the considerable augmentation to in-theater intelligence organizations consisted mainly of relatively untrained augmentees and reservists. It was not so much a lack of intelligence personnel that remained a problem, but a lack of *qualified* personnel.²⁴

Once in the theater, the relationship between the CENTAF operations and intelligence staffs—an uneasy relationship at best in Air Force organizations—experienced further divisions. When Air Staff officers briefed Lt. Gen. Charles A. Horner in Saudi Arabia on the Instant Thunder concept of a strategic air war, the cool reception they received led Central Command and CENTAF intelligence staffs to conclude that the Washington-based plan, along with the officers from Checkmate, would soon recede to irrelevance. Instead, General Horner kept some of the Checkmate planners and formed a secret Special Planning Group, the Black Hole, under Brig. Gen. Buster C. Glosson, to create the offensive air plan. Due in no small part to the political sensitivity of offensive campaign planning at this early juncture, the Black Hole planners set themselves up as a special access organization and made little effort to inform intelligence personnel of their concept of operations.²⁵ CENTAF intelligence went ahead with its own target planning and viewed initial requests from Black Hole planners as a nuisance.²⁶ When intelligence personnel failed to respond expeditiously to their initial requests, the Black Hole regarded

²³(S/NF) Rpt, HQ USAF/IN, "Operation Desert Storm Lessons Learned," 5 May 1991, JULLS Number 41444-77200 (00024), p 50.

²⁴Intvw, Capt Edward O'Connell with Maj Robert Heston, USAF, AF/INX, formerly 37th TFW/IN, 4 Aug 1992; Intvw, Capt O'Connell with Lt William Carr, USN, CENTCOM J-2, 11 Nov 1992; and Intvw, Barry Watts with Capt O'Connell, 9 Apr 1993.

²⁵Intvw, Capt John Glock; and AAR, USCENTAF/IN, "After Action Report and Lessons Learned," 25 May 1991, Col Rauschkolb to Col Christon.

²⁶(S) Intvw, Dr. Perry Jamison, Center for Air Force History, with Lt Col Sam Baptiste, 5 Mar 1992. Tapes at AFCHO.

them as generally nonresponsive and looked elsewhere for support.²⁷ Thus began an unfortunate rift between theater intelligence organizations and the Black Hole, a gap that widened as time went on.

The unfortunate physical separation between the two entities exacerbated an already tender situation. CENTAF's intelligence facility resided in a large tent on a soccer field adjacent to the Royal Saudi Air Force headquarters building, while the Black Hole was located in the basement of that building. Although not far, the physical separation had consequences.²⁸ Theater intelligence personnel did not take part in the many ad hoc discussions that refined the Instant Thunder (Desert Storm Phase I) concept. This meant that they could not anticipate Black Hole requirements. By the time that some intelligence personnel joined the Black Hole staff, the planners had already forged new links to disparate intelligence and other organizations outside the theater.²⁹

Perhaps the single biggest factor that contributed to the rift was the initial inability of theater intelligence to produce imagery of potential targets for General Glosson's planners in a timely fashion. This failure had a variety of sources, beginning with the generally incomplete and out of date national database on Iraq before the crisis.³⁰ Within the theater, no one told intelligence officers of the evolving target list. The collection management system in theater took time to get started, and since the Black Hole was a compartmented operation with little resident intelligence experience, that organization did not fully appreciate or properly

²⁷Rpt, Lt Col J S Meyer, Jr, "Operations Desert Shield/Desert Storm," SAC/CC, 9 Jul 1991, GWAPS, NA 123; (S) Intvw, GWAPS with Lt Col David Deptula, 20 Nov 1991, 20 and 21 Dec 1991, 8 Jan 1992; and Intvw, GWAPS with Maj Gen Buster Glosson, 9 Apr 1992.

²⁸Rpt, Meyer, "Operations Desert Shield/Desert Storm," SAC/CC, 9 Jul 1991; AAR, USCENTAF/IN, "After Action Report and Lessons Learned," 25 May 1991, Col Rauschkolb to Col Christon; and Glock intvw.

²⁹(S) Intvw, GWAPS staff with Lt Col David Deptula, 20 Dec 1991; and Glock and Baptiste intvw. There were, it should be noted, intelligence officers in the Black Hole, but they could not bridge the gap.

³⁰(S) Intvw, Capt John Glock with Maj John Heidrick, 9th TIS/INT, 7 Jan 1992, GWAPS, NA 267.

avail itself of the imagery tasking and prioritization system.³¹ Moreover, few tactical systems in theater could provide the images needed to support planning for a strategic air war.³² And, once the war began, those that were available were not fully used after Horner and Glosson made a conscious decision "not to waste aircraft to shoot pictures of targets we knew had already been struck."³³

Early in Desert Shield during one of General Glosson's trips to Washington, he met with Rear Admiral J. M. McConnell, DIA/J-2, who promised to provide whatever intelligence support he could. The relationship blossomed, and soon Glosson spoke to McConnell several times a day on a secure telephone line. McConnell also used secure facsimile to send intelligence materials into theater, mostly one- or two-page analytic reports on recommended targets with accompanying imagery.³⁴ Other members of the Black Hole, many of them on assignment from the Air Staff, turned to friends in Checkmate. By the middle of Desert Shield, Checkmate had become an ad hoc fusion center for intelligence and operational information and maintained contact with national intelligence agencies and a number of specialized planning cells in Washington. It did not take Black Hole personnel long to realize that they could obtain more current information by calling Washington on their STU-III secure telephones and secure faxes than they could get from in-theater intelli-

³¹ AAR, USCENTAF/IN, "After Action Report and Lessons Learned," 25 May 1991, Col Rauschkolb to Col Christon; (S) Report, Intelligence Program Support Group, Office of the Assistant Secretary of Defense (Command, Control, Communications, and Intelligence), *Operation Desert Shield/Storm Intelligence Dissemination Study-Final Report*, Appendix L-CENTAF, 28 May 1992.

³² (S/NF) Rpt, HQ USAF/IN, "Operation Desert Storm Lessons Learned," 5 May 1991, JULLS Number 41965-98270 (00034), p 68; JULLS 32033-32800 (00028), pp 58-59, GWAPS, NA 136; (S) Rpt, Thomas P. Christie, et al, Desert Storm Strategic Air Campaign Bomb Damage Assessment (BDA), IDA Document D-1088, Jan 1992, pp 3-5, GWAPS, NA 223.

³³ Intvw, Capt O'Connell with Maj Gen Glosson, Pentagon, 28 Jan 1992.

³⁴ (S) Intvw, Rear Admiral J.M. McConnell, Joint Staff Intelligence J-2, by Diane T. Putney, AF/HO, and Ron Cole, JCS/HO, 14 Feb 1992, Pentagon, GWAPS, NA 261. In addition, Checkmate also forwarded such intelligence products to the Black Hole planners.

gence sources.³⁵ By the time the war started, the Black Hole had become its own intelligence organization: it had its own intelligence sources, and it did its own targeting.

CENTAF, of course, did not operate completely independently of the theater intelligence structure. The Central Command Joint Intelligence Center became the senior intelligence organization in the theater, but CENTAF intelligence exercised considerable latitude in weaponeering and other targeting duties. Likewise, CENTAF intelligence reported to a theater battle damage assessment cell on targets attacked in Iraq; the Naval Component of Central Command (NAVCENT) accomplished damage assessments of Iraqi naval facilities and vessels; the Marine Component of Central Command (MARCENT) provided damage assessments of Iraqi ground force targets within the Marine area of operations; and the Army Component of Central Command (ARCENT) reported the damage inflicted on the remainder of the Iraqi ground forces.³⁶ Still, at least as far as the air war over Iraq was concerned, theater intelligence organizations played a smaller role than would have been expected.

The ad hoc relationship between Washington and Riyadh intelligence centers challenged the axiom that intelligence developed in theater is better and more timely than intelligence developed in the United States. With the help of the national intelligence agencies in Washington, the steady stream of requests from the Black Hole met with a corresponding response that over time turned into a steady dialogue. Many times Washington intelligence analysts knew the target had been struck before in-theater analysts did. Furthermore, developing targets for the strategic air campaign often required levels of expertise unavailable in the theater. For example, a special cell formed under DIA/J-2 in Washington to analyze the Iraqi telecommunications system could not be duplicated in Riyadh. This applied to several other target sets requiring technical analysis.

³⁵For an example of the kind of targeting information being provided to the Black Hole from VAdm McConnell and Checkmate, see Lt Col Deptula's targeting folders in GWAPS, CHP, folder 3. In several cases, intelligence reports from CENTAF/IN are dated several days after similar information had been provided by VAdm McConnell or Checkmate.

³⁶*Conduct of the Persian Gulf War*, p 344.

The Black Hole's ready access to targeting intelligence from national intelligence agencies had the unfortunate effect of cutting Central Command J-2 and CENTAF Intelligence out of the communication loop. Theater intelligence organizations continued to perform their functions but found that planners rarely heeded their recommendations because they could never advance their proposals rapidly enough to get them into the fast-paced planning cycle. Even if the Black Hole had worked more cooperatively with theater intelligence, a number of systematic and technical problems that lay beyond the ability of the theater people to solve would have prevented a harmonious relationship. The Washington bypass violated formal channels, but it worked. Operations planners got expert intelligence more rapidly than otherwise might have been the case.

Targeting

The selection of target systems whose neutralization or destruction will achieve the desired operational and strategic objectives has seldom, if ever, been an easy or trivial matter. Uncertainties, gaps, and errors in intelligence about targets and target systems have been the rule, and the Gulf War proved no exception. On the one hand, Gen. Colin L. Powell has argued that the intelligence available to the Coalition "was probably the best in military history."³⁷ In light of the array of advanced collection and reconnaissance platforms available to the Coalition, to say nothing of the degree to which the Iraqis were blinded by Coalition air power, there is considerable truth to this generalization. On the other hand, General Powell has also acknowledged that theater and tactical commanders expressed frustration after the war "over the lack of coordination and timeliness in the dissemination of intelligence collected at the national level."³⁸ Among other things, a significant percentage of the target

³⁷Gen Colin L. Powell, "Report on the Roles, Missions, and Functions of the Armed Forces of the United States" (Washington, DC: CJCS, Feb 1993), p II-13.

³⁸*Ibid.*, p II-13.

materials generated by Washington intelligence agencies and sent to the theater were never disseminated to operational wings.³⁹

What air planners in Riyadh came to refer to as the strategic portion of the Desert Storm air campaign focused on Iraq proper. Most of the "strategic" targets in Iraq proper were fixed installations: airfields, naval ports, permanent troop installations, electric power plants, bridges, telecommunications switching facilities, command and control centers, weapons research and development facilities, fixed Scud launch sites, governmental ministries, headquarters for Iraq's military services, ammunition storage depots, and so forth. These installations generally had basic encyclopedia numbers (BENs) and appeared in the DIA Automated Installations Intelligence File (or AIF). The AIF, which included all installations of interest, and not merely those suitable for targeting, grew some 38 percent between the invasion of Kuwait and the beginning of the air campaign. Within this growth, the list of installations considered as potential targets increased nearly 50 percent by early January 1991.⁴⁰ By and large, the vast majority of the more than 770 strategic targets in Iraq and occupied Kuwait in the Black Hole's final target list had been identified in the AIF before 17 January 1991.⁴¹

The second major component of the Desert Storm air campaign consisted of attacks against Iraqi ground forces in the Kuwait theater of operations. The 43 Iraqi divisions and independent brigades deployed in the KTO had some fixed installations associated with them. However, the vast majority (more than 90%) of the roughly 23,000 strikes by Coalition fixed-wing aircraft and missiles against Iraqi ground order of battle involved potentially mobile forces in the field that did not have basic encyclopedia numbers and were not listed in the AIF. Targets

³⁹(S) Intvw, Capt O'Connell with Maj Heston, 4 Aug 1992; also, Intvw, Barry Watts with Maj Lewis Hill, 13 Apr 1993. Experience by tactical units with the dissemination of targeting materials varied widely from one fighter wing to the next. Some units, such as the F-117 wing, went to extraordinary lengths to obtain needed materials.

⁴⁰(S/NF) Doc, Targets Database compiled by Capt John Glock, USAF, GWAPS files.

⁴¹Being in the AIF basically meant that the installation had a basic encyclopedia number, not that it was one of the 774 unique targets that eventually appeared on the Black Hole's target list.

associated with these forces included tanks, trucks, bunkers, and deployed logistics supplies.

The presence of a target in the DIA's installations and order of battle databases did not mean that pilots had adequate information to conduct an attack. Pilots required photographs and other target materials. Some target folders were prepared in advance and carried into the theater, while others were prepared in the theater, especially as new targets emerged. Combat aircrews at the wing level requested a steady flow of target materials, especially imagery. At one end of the spectrum were systems such as the Tomahawk Land Attack Missile and the F-117 that had prodigious requirements for specialized information. But even in the case of fighter-bombers with less exacting requirements for mission planning, the appetite for target imagery and threat information in the units proved well-nigh insatiable.

In this regard, intelligence analysts had a sometimes ill-defined relationship with operational planners during the Gulf War. Normally, target-intelligence officers from Central Command and CENTAF nominated targets to be attacked according to their own analyses, those obtained from national intelligence agencies, and their understanding of the overall campaign strategy. They went into the war expecting that these nominations would form the basis for each day's air tasking order. But in Desert Storm, operational planners in the Black Hole, relying on their own intelligence sources, made the basic target selections—especially insofar as the strategic portion of the air campaign was concerned. Inevitably, this ad hoc arrangement tended to blur and confuse the relations between theater intelligence and operations.

Once targets were selected, CENTAF and Central Command targeting officers would begin working with DIA and the Defense Mapping Agency Aerospace Center (DMAAC) in St. Louis, Missouri, to obtain the most precise coordinates for the aimpoints to be used in striking them. Two further problems then emerged: the selection of aimpoints and the precision of the coordinates passed to the units. Sometimes aimpoints were selected at CENTAF, but more often they were chosen at unit level. Who had primary jurisdiction for this responsibility—CENTAF or the wings—became a point of both contention and added confusion. In addition, the bombing accuracy possible with platforms such as the F-117s

required geodetic coordinates. Due to problems with incompatible imagery dissemination systems in theater, the Black Hole often ended up trying to pass aimpoints to units with geographically rectified imagery whose quality was nowhere near equal to the geodetic DMAAC coordinates that could have passed through intelligence channels.⁴² Inevitably, passing less-precise coordinates introduced further friction into the targeting process.

These interconnected problems became particularly acute for certain units that depended on high-quality, current imagery for mission preparation. Unfortunately, pilots often flew with outdated pictures of the target or with no imagery at all. For some units, imagery was not critical. But since imagery was a standard part of mission preparation materials, all air crews had come to expect it. It was not good enough to read a message that described the target and its surroundings; they wanted and expected to see a picture of it. Although the intelligence community had successfully provided imagery for target folders for crew study in peacetime, the demand in wartime for imagery and imagery-derived products was not met.⁴³

From a campaign planning standpoint, one of the most far-reaching decisions of the war was the selection of target categories as contrasted with individual targets. The Air Staff's Instant Thunder briefing, as presented to General Schwarzkopf on 17 August 1990, identified ten target categories for an offensive air campaign against Iraq proper.⁴⁴ With some minor modifications the 17 August Instant Thunder target categories were retained by General Glosson's special planning group (the Black Hole) and used throughout Desert Storm. It is possible to argue, based on the overall success of the air campaign, that the limited intelligence data available to

⁴² Intvw, Capt O'Connell with Maj Gen Glosson, 3 Feb 1992; Intvw, Capt O'Connell with Maj Jack Gardner, USAF, CENTCOM Target Intelligence Officer, 5 Aug 1992.

⁴³ *Conduct of the Persian Gulf War*, Appendix C, p 338.

⁴⁴(1) National leadership facilities, (2) national telecommunications and C3, (3) oil distribution and storage, (4) electric power, (5) railroads (to which bridges were later added), (6) nuclear/chemical/biological warfare capabilities, (7) military research/production/storage, (8) strategic air defenses, (9) airfields (particularly those containing interceptors and bombers), and (10) Iraq's ballistic missile capabilities.

the Air Staff in August 1990 were adequate for the selection of target categories. However, the choices of target categories were shaped at least as much by doctrinal considerations about the proper offensive use of air power at the operational level of war as by detailed intelligence on targets and target systems in Iraq. While Air Staff intelligence officers did much to fill in the target categories as best they could, the idea of a strategic air campaign rested upon only the most general understanding of Iraq, its society, infrastructure, and military capabilities.⁴⁵

At the most elementary level, there were individual targets that were never located prior to the end of the war. The concealed "hide" sites from which Iraq's mobile ballistic launchers probably operated throughout Desert Storm provide one of the most telling examples of a set of targets that were not pinpointed even by the final day of the conflict. There were other targets that were to one degree or another located but whose full significance or extent was not understood during the war. Al Atheer, for example, was bombed before the end of the war, but not until afterwards did the Coalition learn about its central importance in the Iraqi nuclear program. Similarly, while Ash Sharqat was attacked as a part of Iraq's ballistic missile program during Desert Storm, it was not until after the war that its involvement in isotope separation came to be fully understood.

What these examples suggest is that notwithstanding the massive amounts of intelligence data produced on Iraqi installations and forces, there were some systemic blind spots. Iraq's nuclear, chemical, and biological warfare programs, along with the extended-range Scuds, were areas that Saddam Hussein wanted to protect as much as possible from Coalition air attacks, and the extent to which the Iraqis were able to do so with concealment, deception, hardening, dispersal, redundancy, and mobility does not appear to have been fully appreciated until after the war. In general, Coalition intelligence located most fixed installations throughout Iraq but did not always appreciate the significance of every

⁴⁵John A. Warden III, *The Air Campaign* (Washington: National Defense University, 1988), pp 51-58; Warden's views may be traced in his series of Instant Thunder briefings, 8-17 Aug 1990, GWAPS, CHSH 5 and 7; and (S) Brfg. Col John A. Warden III for Gen John A. Loh, VCSAF, "Iraqi Air Campaign," 8 Aug 1990, GWAPS, CHSH 7-11; (S) Notes, Lt Col Bernard E. Harvey, Checkmate, 7-8 Aug 1990, GWAPS, CHP 9-1.

installation in relation to target systems any more than did the operational planners and commanders. Regarding Iraqi ground forces in the Kuwait theater, Coalition intelligence provided remarkably complete tactical intelligence on the locations and dispositions of the units there. U.S. ground forces involved in the one-hundred-hour ground campaign seem to have encountered no major surprises, especially in the critical breaching operations: "The enemy was exactly where intelligence said he was, disposed as intelligence described . . ."⁴⁶ In retrospect, however, the greatest gaps in intelligence on targets and target sets seem to have occurred with things like Scud mobile launchers that were inherently mobile or elements of the Iraqi nuclear weapons program that could be moved out from under Coalition bombing and concealed.

From an intelligence standpoint, one of the clear success stories in the Gulf War was the Coalition's rapid neutralization of the Iraqi air defenses and air force. The degree to which Coalition intelligence agencies provided not only the relevant installations and associated order of battle but furnished the requisite understanding of the Iraqis' operational weaknesses was truly extraordinary. As a result, Coalition air forces could concentrate their initial efforts precisely against the weaknesses and vulnerabilities of Iraq's air defenses and air force. By contrast, the Survey did not discern anywhere near the same sophistication on the part of Coalition air efforts against the Iraqi field army in the Kuwait theater, which largely became an exercise in incremental attrition. This asymmetry seems to have arisen as much from the historical preferences of Coalition operators as from weaknesses in Coalition intelligence. But it suggests one area at least in which a closer relationship between operations and intelligence could bear fruit in the future.

Bomb Damage Assessment

Few assertions about the Gulf War could command as much agreement as the inadequacy of bomb damage assessment (BDA), but the Survey found no such agreement about the causes of inadequacy. General Schwarzkopf told Congress that

⁴⁶Brig Gen John F. Stewart, Jr., "Operation Desert Storm, The Military Intelligence Story: A View from the G-2, 3d U.S. Army," April 1991, p 9.

BDA . . . was one of the major areas of confusion. . . . It led to some disagreements. As a matter of fact, it led to some distancing on the part of some agencies from the position of CENTCOM at the time, as to what the bomb damage assessment really was.⁴⁷

Theater planners and intelligence staffs disagreed among themselves and with the Washington intelligence agencies over the levels of damage being achieved by the bombing in Iraq proper and within the Kuwait theater. At the same time, reports from Air Force, Navy, and Marine flight crew members and those of other Coalition air forces agreed that they received little or no bomb damage assessment on the targets they attacked during the entire war.⁴⁸ There were many contributing causes: some organizational, some procedural, and some technical. Some limitations were not failings at all; they were simply limits of what could be known or observed. A review of the major impediments to accurate and timely bomb damage assessment can give some understanding of the dimensions of the problem.

The intelligence staffs were not prepared for the enormity of the task, either in numbers of qualified personnel or in established and rehearsed procedures. Those staffs were particularly not prepared to deal with the number of attack sorties occurring every day of the war. Exercise Internal Look, a valuable learning experience for commanders and planners, could not preview the subsequent bomb damage assessment problems, since that exercise followed the long-standing practice of simulating the production of bomb damage assessment to simplify and shorten the exercise.⁴⁹

⁴⁷Rpt. Investigations Subcommittee on Armed Services, *Intelligence Successes and Failures in Operation Desert Shield/Storm*, House of Representatives, 102d Congress, 2d session.

⁴⁸The only exceptions to inadequate BDA at the unit level were units flying aircraft equipped to bring back video recordings of their weapons' impacts, or those that had their own reconnaissance assets (e.g., F-14Ds capable of carrying the Tactical Air Reconnaissance Pod System).

⁴⁹Rpt. USCENTAF/IN *After Action Report and Lessons Learned*, 25 Mar 1991, from Col Rauschkolb to Col Christon (CENTAF/IN), with 17 attachments.

Although regulations and operation plans detailed organizational structures to handle tasking of national reconnaissance assets, the system did not work well in practice because of inadequate numbers of trained, qualified personnel. To complicate matters further, only a small portion of those assigned to CENTAF intelligence during the crisis had any experience in collection management, while the campaign planners failed to anticipate how massive and time-consuming the bomb damage assessment process would be once the war began.⁵⁰ The CENTAF plan for handling such assessments via three computer workstations required modifications during Desert Shield and reduction to a single computer workstation, but the system was still unproven when the air campaign began.⁵¹ The situation was ripe for breakdowns when unexpected circumstances occurred.

The unexpected took place on the first day of the air campaign when weather presented itself as a formidable obstacle to bomb damage assessment. Heavy overcast during the early days of the war prevented adequate reconnaissance of many strategic targets—most were not covered until 21 January, five days after the beginning of the air campaign. This circumstance put intelligence assessments behind from the outset and derailed the prewar planning assumption that imagery of a target would be available to analysts in time for the target to be revisited, if necessary, two days later. When imagery was not forthcoming, the air tasking order (ATO) process went ahead anyway, and operations planners looked to other sources—mission reports and video recordings—to judge the effectiveness of the previous day's strikes. Eventually, the imagery flow settled into a regular pattern, but a lag remained between collecting imagery of a target and disseminating it to planners for consideration in the ATO cycle.

⁵⁰Doc, Majors P.J. Nagy and F.D. Houston, "Intelligence Operations in Southwest Asia," Marine Corps Research Center Research Paper 92-0008, part 1, Jul 1991, p 3, GWAPS, NA 355; AAR, USCENTAF/IN, "After Action Report and Lessons Learned," 25 May 1991, Col Rauschkolb to Col Christon: Intvw, Mr. Lawrence Greenberg, GWAPS with Capt John Glock, USAF, member of 9th TIS and CENTAF/IN, Jan 1992, GWAPS, TF V files.

⁵¹(S) Rpt, Intelligence Program Support Group, Office of the Assistant Secretary of Defense (Command, Control, Communications, and Intelligence), *Operation Desert Shield/Storm Intelligence Dissemination Study—Final Report*, Appendix L-CENTAF, 28 May 1992.

Collection managers had to set priorities for the imagery collected from limited assets, but these managers often had not taken part in target planning, nor were they aware of changes to the daily air tasking order. Furthermore, Black Hole planners were unfamiliar with collection tasking procedures and did not attend meetings of the coordinating boards that assigned priorities to collection lists. This meant that people not involved in planning the air campaign and unaware of its direction determined each day's reconnaissance requirements.

As in the past, imagery interpretation proved a difficult art. It was difficult to assess damage to Iraqi hardened aircraft shelters, command bunkers, and communication buildings attacked by penetrating bombs. Analysts could see a small hole on the target's exterior where the bomb had entered, but most of the effects were contained within the target. Unfortunately, the requisite expertise on structural vulnerabilities and weapons effects largely resided in Washington, and some hardened aircraft shelters ended up being attacked again and again after they had been penetrated and the aircrews had observed large secondary explosions. The problem of imagery analysis also extended to the Kuwait theater, where assessing the operability of Iraqi equipment became an issue. Unless imagery showed a catastrophic kill, it was often impossible, for example, to determine whether a tank intact after a "near-miss" had its engine, aiming devices, or radios disabled by blast or shrapnel.

CENTAF and ARCENT adjusted to the situation. CENTAF's Black Hole had videotape recordings of F-117, F-111F, and F-15E bombing missions collected and flown daily to Riyadh for analysis. Although these recordings did not have the video quality to permit precise bomb damage, they did show bomb detonation on the targets.⁵² The Black Hole planners used this evidence, for instance, to determine bomb damage of an aircraft shelter, not the later and often indeterminate intelligence assessment from overhead imagery. ARCENT developed a system that combined pilot reports and video readouts with imagery, but at a dis-

⁵²Some "blooming" on the screen at the instant of the detonation made it difficult to determine the exact point of impact.

counted rate.⁵³ The discounting scheme proved a good corrective to pilot reports and even to what appeared on video as a direct hit on an Iraqi tank (discussed in the previous chapter). Still, the result was another manifestation of the bomb damage assessment problem.

Disagreements over what bombing had accomplished were most manifest in the differences between Washington and theater assessments—the dispute over estimates of Iraqi equipment attrition, explained in the previous chapter, being the most notable. Washington intelligence agencies relied on national-level reconnaissance assets to determine what had been destroyed, while Central Command could, in addition, use its limited theater reconnaissance assets and pilot reports. These differences in estimates remained unresolved throughout the war. All the factors combined to make bomb damage assessment one of the most controversial issues of the war. Reflecting on his experience in Desert Storm, Maj. Gen. John Corder (CENTAF's Deputy Chief of Staff for Operations) argued that people expect too much from bomb damage assessment.

At a certain point in time, you're going to have to stand up based on your complete understanding of all sources available . . . If you wait . . . until you're absolutely sure . . . that the bomb damage assessment problem [is] solved, you might have missed the opportunity.⁵⁴

In the end, General Schwarzkopf moved away from the search for precise assessments and refused to display attrition figures in his daily briefings, preferring instead color-coded representations based on the individual enemy division's estimated overall effectiveness.⁵⁵ According to General Horner, by the time the ground offensive began, Schwarzkopf was using the *number* of air strikes against a target, not bomb damage assessment, as his prime indicator of enemy combat effectiveness.⁵⁶

⁵³For example, a 1/3 credit was given an A-10 claim of a kill and a 1/2 credit given an F-111F claim. (S) Msg, ARCENT/G2, dtg 170600Z Feb 1991, GWAPS, CHST 50.

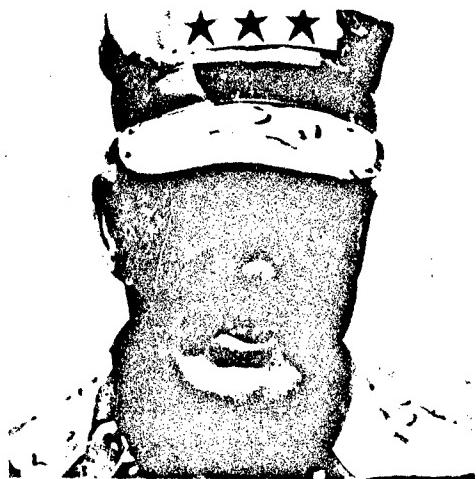
⁵⁴(S) Intvw, GWAPS with Maj Gen John A. Corder, Deputy Commander of Operations, USCENTAF (Nov 1990 to Mar 1991), 18 May 1992, GWAPS, NA 361.

⁵⁵*Conduct of the Persian Gulf War*, p 256.

⁵⁶(S) Intvw, Perry Jamison, et al, AFCHO, with Lt Gen Charles E. Horner, 4 Mar 1992, GWAPS, NA 322.

But even acknowledging that expectations may have been unrealistically high, the bomb damage assessment system failed to meet the requirements placed upon it by the pace and scale of the air campaign. Technical systems could not keep pace with demand, much of the requisite expertise was in Washington rather than in the theater, and too many breakdowns apparently occurred in the transmission of information between Washington and Riyadh.

Intelligence's record in the air war is mixed, with remarkable successes as well as notable (but far from fatal) failures. The accurate strategic assessment of Iraqi intent and capabilities following the August crisis and the mass of detailed information about a wide range of targets acquired from August 1990 through February 1991 contributed immensely to the air campaign. The overall misestimate of Iraqi order of battle and inadequate bomb damage assessment were the largest failures. Explanations for the former lie in part with the relative neglect of Southwest Asia before the Iraqi invasion of Kuwait. Central Command's area of responsibility had a far lower priority than other regions during the Cold War, as the post-August scramble for information and staffs to process it clearly shows. A pervasive failure to practice bomb damage assessment regularly on a large scale before the war—a failure shared by commanders as well as intelligence organizations—set the stage for its inadequacy during the war. Realistic practice would have uncovered large technical, procedural, and organizational problems; such rehearsal may have suggested remedies that could not be improvised during five and a half months of crisis and six weeks of war.



(Top) The Joint Force Air Component Commander, Lt. Gen. Charles A. Horner, USAF. (Bottom) Brig. Gen. Buster C. Glosson, USAF, and members of his staff in the Iraqi Planning Cell of the Directorate for Campaign Plans (the Black Hole).



Who Ran the Air War?

One of the more controversial aspects of the air campaign in the Gulf was the role of the Joint Force Air Component Commander (JFACC, pronounced "Jay Fack") in the person of Lt. Gen. Charles A. Horner, Commander of Central Command's Air Force Component (CENTAF). Gen. H. Norman Schwarzkopf gave him authority to control most Coalition air power. Horner used that authority with sufficient discretion to get his job done while maintaining good relations with the other Services and the allies. Indeed, some would argue after the war that his contribution had been to coordinate rather than to command or control.¹

The idea of a single commander for air goes back at least to World War II. The Air Force position has long been that of War Department Field Manual 100-20, issued 21 July 1943: "Control of the available air power must be centralized and command must be exercised through the air force commander if [its] inherent flexibility and ability to deliver a decisive blow are to be fully exploited."² Centralized control, however, has usually proved difficult to implement. In Southeast Asia, a convoluted chain of command divided North Vietnam into seven geographic areas, called "route packages." These packages were then apportioned between the Navy and the Air Force for separate air operations. Strategic Air Command retained control of B-52s flying throughout the theater, while the Marines and the Air Force struggled for control of the former's aircraft in South Vietnam.

¹(S) See, for example, David L. Dittmer, *U.S. Marine Corps Operations in Desert Shield/Desert Storm, Vol I: Overview and Summary* (Alexandria, VA: Center for Naval Analyses, 1992), p 36.

²This reflected in part the experience of early fighting in North Africa, when aircraft had been parceled out to Army corps—a failure which has influenced Air Force thinking ever since. See Benjamin F. Cooling, ed, *Case Studies in the Development of Close Air Support* (Washington: Office of Air Force History, 1990) and Daniel R. Mortensen, *A Pattern for Joint Operations in World War II, North Africa* (Washington: Office of Air Force History and Army Center of Military History, 1987).

Although "JFACC" became official Joint Chiefs of Staff terminology in the mid-1980s, old tensions between the Services over control of theater air power were not completely resolved. The Marine Corps agreed to make sorties available to the JFACC for air defense, interdiction, and reconnaissance, but the Marines would give up their direct support sorties to JFACC control only after Marine requirements had been satisfied. The Navy would continue to control sorties it deemed necessary for fleet defense, and the Army would fly its helicopters with few constraints from the JFACC. Nevertheless, the notion that joint air operations required at least a coordinating authority gained ground.³

Meanwhile, Central Command began preparing for a JFACC in Southwest Asia. By the time draft Operations Plan 1002-90 appeared in the spring of 1990, a fairly conservative definition of the JFACC's functions had taken shape. Those functions were "planning, coordination, allocation, and tasking based upon U.S. Commander-in-Chief Central Command (USCINCCENT) apportionment decisions."⁴ Schwarzkopf would use Horner's recommendations to decide how much air power would be apportioned among missions or geographic areas; Horner would then allocate particular forces to particular targets. Horner would have "operational control" of Air Force units but only "tactical control" of aircraft sorties made available by the Navy and the Marines.⁵ In the coming months, Schwarzkopf would permit Horner to make the most of this limited authority.

³For an early use of the term "JFACC," see Msg, JCS Chairman, subj: Joint Doctrine for Theater Counterair Operations, 4 Mar 1986. The Air Force and Marine Corps had already reached an "omnibus agreement" in 1980, and this was reaffirmed by JCS Pub 12, Vol IV, in 1986.

⁴Draft CENTCOM OPLAN 1002-90, 18 Jul 1990, p 28. This language had already been used in JCS publications, including Joint Pub 1-02, *Department of Defense Dictionary of Military and Associated Terms*, 1 Dec 1989, and would be echoed in the operations orders for Desert Shield. Joint Pub 1-02 was careful to point out that the JFACC's functions would "include, but not be limited to" this list.

⁵Joint Pub 1-02 (1 Dec 1989) defined "tactical control" as the "detailed and, usually, local direction and control of movements or maneuvers necessary to accomplish missions or tasks assigned." It defined "operational control" as the "authority to perform those functions of command over subordinate forces involving organizing and employing commands and forces, assigning tasks, designating objectives, and giving authoritative direction necessary to accomplish the mission."

The JFACC and the Tactical Air Control System

General Horner did not have a joint staff. To begin with, he had only the staff that normally served him in peacetime as commander of Ninth Air Force. In Riyadh, that staff expanded to handle wartime responsibilities both for CENTAF and for the JFACC, but the new members were mostly Air Force with only a few liaison officers from the other Services and the allies. This fact would shape the way Horner exercised his authority as JFACC and cause some lingering suspicion among the other Services.

Horner inherited a mechanism for controlling air power called the "Tactical Air Control System" (TACS). The TACS was designed to control theater-level air operations focusing on the battlefield. Here, however, it would be called upon to conduct an independent strategic air campaign as well. This mechanism included forward air control officers (on the ground with Army units or flying above them) linked to a hierarchy of airborne and ground command posts culminating in the air component commander's Tactical Air Control Center (TACC).

Horner tailored the Tactical Air Control System for the task at hand in ways that made some of his staff uncomfortable. Most of these changes centered on a small planning group that began outside the TACC and eventually absorbed many of its functions. Horner brought in Brig. Gen. Buster Glosson to run this special planning group, whose original four members came from Washington, where Glosson had also served until his recent transfer to Central Command.⁶ Horner wanted Glosson's group to work in great secrecy while planning an offensive air campaign. After they moved into the basement of Royal Saudi Air Force headquarters (which CENTAF shared), the old CENTAF staff began to call them the "Black Hole." Eventually, the Black Hole grew to about 50 personnel in a CENTAF headquarters staff of more than 2,000.

⁶Glosson was Deputy Assistant Secretary of Defense for Legislative Affairs until July 1990, when he became Deputy Commander of CENTCOM's Joint Middle East Task Force. The fact that he was already working for Schwarzkopf may have contributed to their good relationship throughout Desert Shield and Desert Storm. Similarly, Horner already knew Glosson before picking him to run the offensive planning effort.

While the Black Hole quietly planned the campaign that would be executed, the rest of the CENTAF staff was left to plan for daily training missions and refine evolving plans for defending Saudi Arabia should Iraq invade. As August turned into September and the latter prospect became less likely, much of Horner's staff remained isolated from the offensive planning effort. This caused some bitterness, even after December when the Black Hole was better integrated into the CENTAF staff and Glosson was put in charge of all planning under a new deputy chief of staff for operations, Maj. Gen. John Corder. However, Horner preserved a formal direct link to Glosson by putting him in command of all CENTAF's fighter wings. As a consequence, both Corder and the rest of the TACC could be bypassed by Glosson, who could talk directly to Horner and Schwarzkopf on the one hand and to wing commanders on the other.⁷

The approximately 300 CENTAF personnel formally responsible for providing intelligence were even more frequently bypassed. Glosson decided early in Desert Shield that the CENTAF intelligence staff could not meet his needs fast enough. He and his Black Hole staff developed their own links to the Washington intelligence community, which often sent them information days before it made its way through channels to CENTAF intelligence. Normally, the TACC was the meeting ground where the CENTAF intelligence staff put its products to work for the operations staff. Now, the Black Hole had direct access to its own sources through Checkmate and Rear Admiral McConnell in Washington.⁸

When Glosson took charge of CENTAF planning in December 1990, he also took charge of Horner's principal tool for asserting authority as JFACC: the Air Tasking Order, or ATO. During Desert Storm, each

⁷Glosson commanded the 14th Air Division (Provisional); Brig Gen Glenn A. Proffitt, II, the 15th Air Div (Prov), which included electronic warfare and control aircraft; Brig Gen Patrick P. Caruana, the 16th Air Div (Prov), which included B-52 bombers, tankers, and strategic reconnaissance aircraft. Brig Gen Edwin E. Tenoso, the 1610th Airlift Div (Prov).

⁸See Chapter 4 of this report.

day the ATO listed details about almost every Coalition fixed-wing sortie scheduled over the Arabian peninsula and Iraq.⁹ The other Services and the allies readily appreciated the importance of being in the ATO, if only to avoid mid-air collisions with any of the more than two thousand sorties flown daily during the air campaign. Besides, the great distances of the theater demanded air refueling by Air Force tankers, and that was arranged through the ATO.

Nevertheless, the ATO's many critics said that its hundreds of pages were too cumbersome.¹⁰ In earlier wars, the Air Force had handled as many sorties by sending each unit only the fragment ("frag") of the daily order that applied to it. The arrival of networked computers in every unit, however, had encouraged CENTAF to send the complete order to all through its Computer Assisted Force Management System (CAFMS). The units could then scroll through the order on a monitor and print only the relevant portions. But the volume of communications overwhelmed old transmission equipment and computer terminals. Some units reported that transmission and printing were taking more than five hours. In this context, flying the ATO to Navy carriers may not have been a bad alternative, even if the carriers had the necessary hardware (which they did not). Partly because Pacific Air Force (PACAF) and U.S. Air Forces in Europe (USAFE) did not share CAFMS and had their own systems, Navy carriers resisted using any of their crowded space for a system that might not be the right one.¹¹ Furthermore, many units had already received the

⁹Some helicopter sorties were included in the ATO, but most were not. Navy and Air Force cruise missiles were in the ATO, but Army tactical missiles were not.

¹⁰The number of pages in the ATO varied both with the day and with the means of transmission. The peak was Day 40 of Desert Storm, the second day of the ground offensive. When sent through CAFMS, that ATO required 982 screen pages; sent through the AUTODIN message system, it required 261 pages (131 sections). Many units used their STU-III secure telephones (with modems) for more rapid reception. For a discussion of CAFMS by authors involved in its creation from the late 1970s and in its use during the Gulf War, see John Paul Hyde, Johann W. Pfeiffer and Toby C. Logan, "CAFMS Goes to War" in Alan D. Campen, ed, *The First Information War* (Fairfax, VA: Armed Forces Communications and Electronic Association, 1992).

¹¹Attempts to install CAFMS at sea during Desert Shield were frustrated by the aircraft carriers' lack of suitable communications equipment.

most essential information over the telephone long before the ATO arrived electronically or physically.

Some critics of the ATO complained that it took too long not only to transmit and receive but also to prepare. After the war, one report on the Marine experience said that the ATO was "an attempt to run a minute-by-minute air war at a 72-hour pace."¹² This criticism was not entirely warranted because most Marine sorties went into the Kuwait theater of operations, and many were handled by airborne controllers on a minute-by-minute basis. Indeed, in the case of fixed targets in Iraq, the opposite complaint was made; instead of permitting the ATO process to plan at least two days in advance, Glosson was prone to calling his wing commanders with last minute changes.

The three-day ATO process began with the creation of a Master Attack Plan in the Iraq target planning cell (the Black Hole) and the KTO target planning cell (drawn from the old CENTAF staff). The Master Attack Plan was much shorter than the ATO because the former included less information and dealt with fewer sorties. The Master Attack Plan that dealt only with sorties that penetrated Iraq and Kuwait air space did not include air refueling and airlift sorties. In addition the Master Attack Plan listed only times on target, mission numbers, target numbers, target names, aircraft types, and number of aircraft. The ATO added radio call signs, munition loads, identification "squawk" codes, air refueling guidance (tanker call signs, mission numbers, and tracks), and special instructions (or "spins") on air refueling procedures, airspace control, rescue, communications, jamming, and so forth. Since the Master Attack Plan listed strike packages chronologically according to time on target, it offered a more comprehensible picture of the air campaign than the ATO, which listed sorties by unit. The Master Attack Plan was a new tool for building a more coherent ATO.

¹²John D. Parson, Benjamin T. Regala, and Orman H. Paananen, *Marine Corps Desert Storm Reconstruction Report, Vol IV: Third Marine Aircraft Wing Operations* (Alexandria, VA: Center for Naval Analyses, 1992).

On any day during the war, the Black Hole would be developing the Master Attack Plan for the air campaign to be waged two days ahead, while the ATO shop was preparing the order for the next day and the rest of the TACC monitored the execution of the current ATO. In practice, of course, this process often appeared chaotic. A myriad of details needed coordination, and the JFACC or senior planners could change taskings at any time on the basis of hot information-intelligence tips, pilot debriefings, or weather shifts. The flying units (which would usually have the night of the second day to complete their planning) also had opportunities to shape the ATO, often through telephone conversations with the Black Hole early in the process. As a result of these ingredients, the ATO sometimes went out late or incomplete (particularly early in the air campaign) and was still subject to change in any case.

The JFACC and the CINC

The role of the JFACC in the Gulf War can be clarified by examining three relationships General Horner developed during the course of Desert Shield and Desert Storm: with the theater commander, with the other American components, and with allied forces.

In the early days of Desert Shield, General Horner served as Central Command's forward commander in the theater—a role that made particular sense in view of the immediate priority given to flying aircraft into the theater. By the end of August, General Schwarzkopf had at his disposal some U.S. ground forces and substantial air power. Iraqi forces had not moved into Saudi Arabia, and the prospect of their doing so seemed increasingly unlikely. General Horner began to pay more attention to the offensive planning responsibility he had assigned General Glosson.

Schwarzkopf now gave Horner a fairly free hand in planning offensive air operations. Standard procedures called for the creation of a Joint Target Coordination board with representatives from each component to nominate targets for air attack. The Black Hole took over many of the functions normally assumed by such a board. This appears to have been an expedient decision on the part of a command that had very little staff in peacetime and whose augmented but overworked staffs during the Gulf crisis were consumed by the task of deploying hundreds of thousands of

troops and thousands of machines to the area of operations. Moreover, to leave planning for an air offensive almost entirely to a cell in the air component would allow for maximum security. In any case, Schwarzkopf for months remained more comfortable with the work of the Black Hole than with plans prepared for a ground offensive. Especially because he was his own ground commander, Schwarzkopf and his Central Command staff gave much more time to ground planning.¹³

Once the war began, Horner briefed Schwarzkopf nightly on target selection, although not on bomb damage assessment. The two commanders purposely avoided the bean-counting or body-counting that had plagued commanders during the Vietnam War, although Schwarzkopf's requirement for fifty percent destruction of Iraqi armor and artillery in the Kuwait theater before the ground offensive sometimes threatened to degenerate into such an exercise. Schwarzkopf and Horner were of course interested in whatever the intelligence community could tell them about bomb damage, using sometimes conflicting reports that came from Washington and from in-theater organizations. Schwarzkopf reviewed the planned air operations and changed them on occasion, although for the most part he consigned the strategic air campaign to Horner and his staff. Schwarzkopf also served as a conduit for Washington guidance on waging the war. Such guidance often pertained to escalating the pursuit of Scud missile launchers capable of firing at the Israelis and to restricting bombing in Baghdad following the attack on the Al Firdos bunker.¹⁴

The story was rather different in the Kuwait theater. Here, Schwarzkopf directed the JFACC to concentrate initially on second- and third-echelon Iraqi forces—the heavy divisions and the Republican Guards making up the operational and strategic reserves of the Iraqi Army. He also expressed particular concern over the need to prevent Iraqi forces from escaping the theater. Horner adhered to Schwarzkopf's priorities, but corps commanders did not always agree with Schwarzkopf's choices. They were more concerned about the forces immediately to their front

¹³It is noteworthy that Schwarzkopf's memoirs devote relatively few pages to the air war.

¹⁴(S) Intvw, USAF historians with Lt Gen Charles A. Horner, Shaw AFB, 4 Mar 1992, GWAPS, NA 303.

and also complained that too much effort was expended on tanks, which were less to be feared than artillery, especially if the Iraqis resorted to chemical shells. Here again, not realizing it was Schwarzkopf's apportionment, some ground commanders blamed Horner. The upshot resulted in tension between ground commanders, who felt their needs were not being met, and the JFACC and his staff, who were responding to the theater commander's direction.

The JFACC and the Components

The notion of a single air commander had troubling implications for the Army, the Navy, and the Marine Corps. For the Army, the JFACC *per se* was acceptable, even desirable, but corps commanders feared that their needs would not receive adequate attention from an Air Force that might wish to fight its own war in its own way. As in the past, the Army to some degree wanted an allocation of sorties to use as it saw fit. The Navy, concerned about fleet defense, had reservations about a JFACC who could control rather than just coordinate. And the Marine Corps, organized on the basis of the Marine Air-Ground Task Force, whose aircraft could remedy relative weaknesses in artillery and tanks, believed that control of its own aviation was essential.

Air Force-Navy relations sometimes reflected procedural and doctrinal differences. The physical location of Vice Admiral Henry Mauz, and later Vice Admiral Stanley Arthur, aboard the USS *Blue Ridge* (rather than in Riyadh) made matters worse; the inability of the aircraft carriers to receive the air tasking order electronically further hindered cooperation. Substantive disagreements occurred as well. The Navy favored more permissive rules of engagement than the Air Force thought prudent. The Navy appealed the dispute between Horner and Arthur (with the former's consent) to General Schwarzkopf, who supported Horner's more restrictive rules of engagement.¹⁵

¹⁵(S/NF) See Msg from COMUSNAVCENT to USCENTAF, Personal for Lt Gen Horner from Arthur, subj: Rules of Engagement, 112120Z Jan 1991.

The Navy retained control of air-to-air and air-to-surface sorties for the purpose of fleet defense. The Marine Corps was able to reserve large numbers of sorties for its own use on land—at least half of its F/A-18s and all of its AV-8Bs. Nonetheless, unified command did enable the JFACC to make other use of aircraft from both Services, particularly in the first few days of the campaign. As the campaign wore on, Marine aircraft struck fewer fixed targets and concentrated on Iraqi ground forces opposite the Marine sector. Marine fighters were directed to bomb in geographical sectors under the direction of ground and airborne controllers, as were Air Force and other bomber aircraft in the Kuwait theater. Some Marines would later say that their planners “gamed” the ATO by overbooking it with sorties to give them flexibility.¹⁶ In fact, the ATO already provided for such flexibility by scheduling as much air power as possible in the Kuwait theater and leaving “targeting” to airborne controllers.

The Marine commander Lt. Gen. Walter Boomer, Central Command's Army Component (ARCENT) Commander Lt. Gen. John Yeosock, and Army corps commanders Lt. Gens. Gary Luck and Frederick Franks expressed major concern over apportionment of air power to support their forthcoming attacks against the Iraqi front. On 31 January, General Schwarzkopf told General Horner that

Target development and nomination during the early phases of the campaign were clearly led by the . . . (JFACC). As we move into battlefield preparation, maneuver commander input into the target selection process becomes even more important. Therefore, the opportunity for corps and other subordinate commanders to plan for and receive air sorties to fly against targets of their choosing must increase.¹⁷

Although he dealt directly with the Marine Corps' Boomer, Horner handled the Army corps commanders through Yeosock. Indeed, Horner and Yeosock shared an apartment, and the corps commanders could not be sure how much one affected the other's decisions regarding corps

¹⁶Lt Gen Royal N. Moore, “Marine Air: There When Needed,” *Proceedings*, Nov 1991, p 63.

¹⁷(S) Msg, USCINCCENT to COMUSCENTAF, subj: Air Apportionment Planning, 311650Z Jan 1991, in TACC Current Ops Log, GWAPS, NA 215.

target recommendations. Schwarzkopf instructed Horner to meet daily with Lt. Gen. Calvin Waller, Schwarzkopf's deputy, to review the requests by ground commanders for sorties. But Schwarzkopf's own preference for striking Republican Guards sometimes continued to outweigh his corps commanders' preference for striking frontline forces.¹⁸

Tensions between the Air Force and American ground commanders persisted because the commanders did not understand that many decisions causing them problems were Schwarzkopf's and not Horner's. Sometimes Schwarzkopf's decisions did please the ground commanders. For example, they liked to see B-52s dropping bombs in front of their positions, and Schwarzkopf often obliged. As General Boomer noted later, ground commanders like himself had been closer to B-52 strikes in Vietnam than any Air Force officer and knew their psychological impact first hand. Schwarzkopf ordered extensive B-52 bombing of Iraqi troops (who were dispersed and dug in) despite reservations on the part of Air Force officers who preferred to use the big bombers against more vulnerable area targets like supply depots.

In the dispute over the best use of precision bombing in the KTO, however, Schwarzkopf made decisions which displeased his ground commanders and caused grumbling about the JFACC's execution of those decisions. Not only did Schwarzkopf emphasize bombing Republican Guards rather than frontline forces, but he shared Horner's enthusiasm for "tank plinking" (the destruction of tanks with precision guided bombs)—an enthusiasm that was not shared by Generals Franks and Boomer. They were confident that their tanks would easily outmatch Iraqi counterparts and were far more concerned about Iraqi artillery, which could make a Coalition ground attack extremely costly—especially if chemical shells hit Coalition troops during a breach of Iraqi defenses. For their part, the JFACC's air campaign planners complained that targets nominated by ground forces were often out of date and had already been disabled by previous air attacks.

¹⁸(S) Memo, Lt Gen Waller to commanders of ARCENT, CENTAF, MARCENT, and SOCENT, subj: Air Apportionment Guidance, 15 Feb 1991.

Most of the demand for more bombing of Iraqi frontline troops was coming from VII Corps.¹⁹ Since the Marines used much of their own air power for that purpose, they were relatively satisfied. XVIII Airborne Corps hoped to avoid Iraqi front lines entirely by executing a flanking movement into empty desert. As for VII Corps, even its planned thrust was shrouded in enough secrecy to make especially heavy bombing along its front unwise. In the last two weeks before the ground offensive, Schwarzkopf did increase bombing in front of VII Corps almost to equal the bombing intensity elsewhere along the front lines.²⁰

The month-long pounding of Iraqi ground forces before the Coalition ground offensive was not the kind of warfare Coalition airmen had prepared for before the Gulf crisis. Rather they had trained to support troops against an enemy offensive. However, the tactical air control system designed to do the defensive close support job could also move ahead easily to support Coalition ground forces when they finally launched their offensive.

General Horner used a "push" close air support technique to feed sorties steadily to the battlefield where ground commanders and airborne controllers could direct strikes in clear weather. Although the battlefield was sometimes obscured by bad weather and smoke from burning oil wells, the ground work laid by air power in the preceding weeks meant that the ground offensive met little opposition and required little close air support.

During the ground offensive, Horner assumed a more important task—helping to block an enemy retreat. The outcry over the "Highway of Death" and the early cease-fire conspired with the weather to permit much of the Republican Guard to escape destruction. One aspect of this interdiction failure was a dispute over the proper use of the Fire Support Coordination Line (FSCL, pronounced "fissile"). Ground forces used the FSCL to integrate fire support with their movement and to protect their troops from fratricide by "friendly" air attack. In the area between Coalition ground forces and the FSCL, Coalition aircraft could only attack

¹⁹Intvws, GWAPS with Gen Frederick Franks, 3 Sep 1992, and Maj Gen Thomas Rhame, 11 Jul 1992.

²⁰See the GWAPS *Statistical Compendium*, Table 180, especially kill boxes ADS and AES.

under direction from ground or airborne controllers. As the JFACC corollary to this rule, helicopters and tactical missiles beyond the FSCL would be controlled by the JFACC. The FSCL definition said little about coordination of weapons employment beyond the FSCL, however, and the corps commanders considered supporting fires beyond the line as "permissive," requiring no further coordination. That is, they resisted any restrictions on employing missiles or helicopters beyond the line and saw attempts to include such strikes in the air tasking order as efforts to put their organic firepower under JFACC control. To avoid JFACC control, XVIII Airborne Corps advanced the FSCL well north of the Euphrates River on 27 February and thus reserved an area for attack helicopter operations unconstrained by any requirement to coordinate with the JFACC. The effect of this use of the FSCL was to hamper air power's ability to destroy escaping Iraqi ground forces until the FSCL was finally pulled back after several hours.²¹

The dispute over the FSCL during the ground campaign had been building during the air campaign. The corps commanders were dismayed to find that until they launched their offensive, Schwarzkopf would not permit them to move the FSCL beyond the Saudi border. Since the JFACC had the principal responsibility for preparing the battlefield, the corps commanders were not given the air control they had come to expect during the years of preparing for war in Europe. But visions of that war had never included an enemy army that would sit for weeks while bombing fatally weakened it.

The JFACC and the Allies

General Horner came into the war with several years' experience in dealing with the Persian Gulf nations, including a cordial relationship with the commander of the Royal Saudi Air Force, Lt. Gen. Ahmed

²¹(S) TACC log 27 Feb 1991, GWAPS, NA 215; TACC historian notes, Saluda, GWAPS, NA 200; and Intvw, GWAPS with Maj Gen John A. Corder, 18 Mar 1992, GWAPS, NA 361. Discussions among the Services and Joint Staff after the war have produced a more workable arrangement for coordinating strikes beyond the FSCL (Joint Staff, "A Doctrinal Statement of Selected Joint Operational Concepts," 23 Nov 1992, pp 15-19).

Ibrahim Behery. Good working relations helped smooth what might have been a difficult relationship. Half a million young American men and women poured into a country with a small population and very different customs. Since the Americans provided the bulk of the forces, they dominated the Coalition, and they did so in ways that were usually sensitive to the views of the Saudis and the other allies. Schwarzkopf and Horner cooperated with the Saudis in putting as many of the Americans as possible well outside the cities. The command solution adopted was not the creation of a truly unified command but rather of a parallel structure that put all Arab forces under a Saudi officer, Lt. Gen. Prince Khalid bin Sultan al-Saud, who was Schwarzkopf's counterpart. Horner and Behery shared a similar relationship on paper and exhibited compatible personalities. Both Behery and Khalid had attended the Air War College at Maxwell Air Force Base, Alabama.²²

From the beginning of the American deployment, Saudi and American personnel cooperated closely on planning the defense of Saudi Arabia and producing the daily air tasking order. The latter process, with which the Royal Saudi Air Force was familiar, allowed the Saudis a measure of control over the air operations unfolding in their country. The Saudis, for example, initially prohibited low-altitude flying, live bomb training runs, and breaking the sound barrier.²³ The offensive plan for war with Iraq was developed with less Saudi participation. Nevertheless, by the end of 1990, Saudi planners had joined the Black Hole, where British planners had hitherto provided the only allied involvement.

Other nations also seemed reasonably comfortable with the authority exercised by the JFACC. They could not begin to duplicate his command and control apparatus, and the allied air commanders were eager to do everything they could for him. They were restrained in doing so only by restrictions placed on their activities by their governments. The French government, for example, insisted at the outset that French air be used only in support of French troops. But the French government came around and eventually permitted French air units to operate far to the east

²²Intvw. GWAPS with Lt Gen Behery, Riyadh, 11 Jul 1992, GWAPS, NA 377.

²³(S) Msg, CENTAF Sitrep, 191800Z Aug 1990, GWAPS, CSS 12.

of their ground units. Whenever Coalition governments stood aside, their airmen displayed a practiced capacity for working as allies. NATO forces were especially familiar with American procedures, and the Saudis and other Coalition members had sent pilots to the flying range at Nellis Air Force Base, Nevada, for Red Flag exercises.

Allied cooperation did not, however, simply make Coalition air forces extensions of the U.S. Air Force. The governments concerned kept control over the targets that their forces could strike; on the whole, the limitations were neither burdensome to the JFACC nor substantially different from those imposed on American forces. Nonetheless, the weapon systems foreign air forces favored did at times shape Coalition tactics. Most notable was the Royal Air Force's strong preference for JP-233, a runway cratering and mining munition that required low-level flight over Iraqi air fields. Horner's B-52 wings also wanted to execute low-level attacks on runways, but by and large, American fighter commanders did not think that runway attack was all that necessary (given Coalition air superiority) or even productive (given Iraqi capability to repair runways, the extent of their airfields, and the density of antiaircraft gun defenses that made low-level runs very hazardous). But again, because of the abundance of Coalition aircraft and initial uncertainty about how much of a fight the Iraqi air force would make, there was at first no strong impetus to recommend a different use of RAF aircraft. Not until the RAF had lost some aircraft in the opening days of the air campaign did Horner suggest that they might use other bombs on other targets from medium altitude. Even then, the decision was left to the discretion of RAF commanders.

Unified Control of Air Power

The emergence of a single air component commander for Desert Storm attested to an effective control over an exceedingly crowded air space. A single air commander also allowed a degree of coherence in the conduct of air operations that would not have occurred had most air forces been assigned separate operating areas ("route packages") as in Vietnam. Horner resorted to something like a route package only for northern Iraq, since European Command's Joint Task Force Proven Force in Turkey could best reach those targets, with its own equipment provid-

ing air refueling and escorts. Even in this case, however, the Black Hole provided Proven Force with target lists and included Proven Force strike sorties in the Master Attack Plan.²⁴

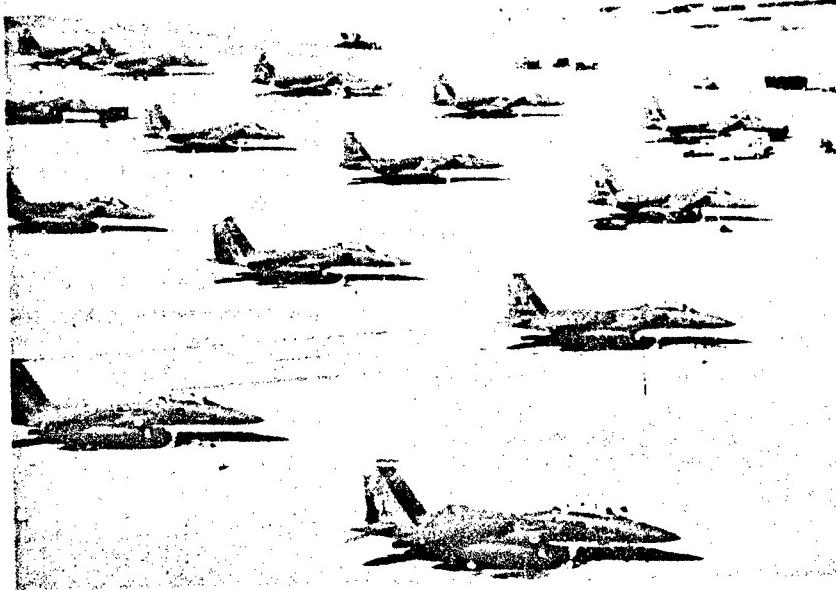
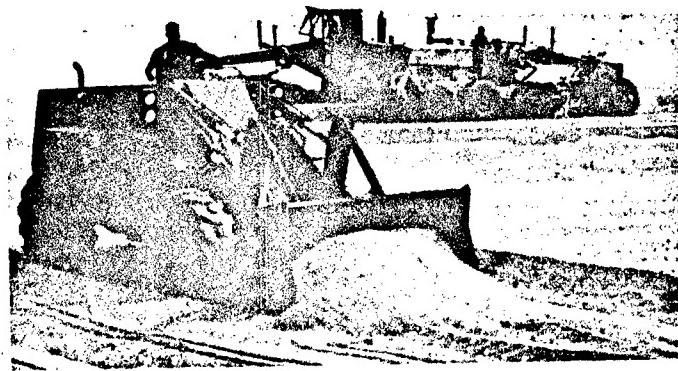
On the whole, the theater commander wielded air resources as a unified force. Moreover, air forces from many nations operated with a harmony rarely seen at the outset of any large war and could conduct combined operations with relative ease. Circumstances overwhelmingly favored this happy outcome. The superabundance of Coalition aircraft, the absence of serious opposition in the air or effective attack against Coalition air bases, and the ability of the Coalition to choose the timing of the war's beginning all meant that neither the theater commander nor the JFACC ever had to make harsh choices in less favorable circumstances. They never, for example, had to strip Marines of air support provided by Marine aircraft; they never had to endanger the fleet by leaving it with less than full air defenses in the face an Iraqi air attack; they never had to pull air cover from the soldiers of an ally in the face of enemy attack.

Furthermore, the war did not witness complete control of all air power by the JFACC. In addition to Proven Force's de facto route package in northern Iraq, the Navy controlled fleet air defense sorties and the Marines controlled direct support sorties. It was not necessary for the JFACC to share much authority with the Central Command staff (including the operations deputy). Although a Joint Target Coordination Board formally existed, its real authority was limited.²⁵ In practice, most critical recommendations and decisions about the apportionment and allocation of air power were made by the theater commander, the JFACC, the Black Hole, and the TACC. Certainly, the concepts underlying the air campaign directed against Iraq proper had not come from the Central Command staff, although the theater commander himself did personally shape their implementation.

²⁴(S) Msg, USCINCEUR/ECJ3 to USEUCOM components and USCINCCENT/J3, Order 001, 231243Z Dec 1990.

²⁵Most of the board's members were below the rank of full colonel. See USCENTAF Combat Plans records and schedules, AFHRC, microfilm roll 23643.

Ultimately, the result was probably a more coherent application of air power than would have resulted from the compromises required by a stronger joint targeting authority. The JFACC's authority in targeting, just as the arrangements settled on for other command and control arrangements for air operations, developed to a great degree in reaction to the situation the Coalition forces faced in the theater. That situation involved organizing air power of tremendous capabilities to fulfill the sweeping objectives planned for its employment. At the time, too, there was little experience or guidance concerning the power of the JFACC. The JFACC did not play by the book, but it is by no means clear that playing by the book would have achieved more.



What were the Conditions in the Theater?

Planners for operations in any theater attempt to anticipate not only the physical conditions of the area in which they must operate but also the political circumstances. In both cases, Desert Shield and Desert Storm presented commanders and staffs with a number of surprises. The political circumstances assumed in prewar plans differed from those actually applying to deployment to the Arabian peninsula. The physical conditions of the theater, although anticipated, differed greatly from those experienced by U.S. air forces in the past. Understanding these differences affords a clearer picture of the circumstances under which air power was employed in the Gulf War.

Political Factors

The Gulf crisis began during international political conditions uniquely favorable for forming a broad Coalition of states to oppose Iraq. The blatant character of the Iraqi aggression, condemned almost universally in the Arab world, promoted local support for a large U.S. force deployment to the region. Iraqi efforts notwithstanding, the crisis remained detached from the Arab-Israeli conflict, which had long complicated American relationships with Arab states in the region. At that same time, the dissipation of the NATO-Warsaw Pact confrontation allowed both NATO and former Warsaw Pact members to support the deployment and contribute forces. Unlike American experience in the 1973 Arab-Israeli War and the 1986 raid on Libya, the United States encountered few difficulties in securing overflight rights and obtaining access to bases within and leading to the theater. In all respects, the political circumstances favored the early, massive deployment of air power to the region.

The key countries along the route from the United States to the Arabian Peninsula and on the Peninsula itself gave swift or blanket approval for the air deployments. The nonstop deployment by fighter and bomber aircraft along an "Atlantic Bridge" to the Gulf required staging

aerial tankers at numerous bases from Lajes Air Base in the Azores to Cairo West Airfield in Egypt. Their access was speedily negotiated. Hellenikon Air Base in Greece and Torrejon Air Base in Spain became key locations even though U.S. forces had begun leaving the bases before the Gulf crisis at the insistence of the host governments. Later on, several East European countries granted overflight rights, as did Thailand and India for air missions across the Pacific.

There were some exceptions to this unprecedented extension of staging and overflight rights, most notably the basing of B-52s requiring bases with extensive runway and ramp operating areas and access to specialized logistical support. The stationing of B-52s overseas raised political concerns for several potential host nations. Throughout the aircraft's history, host foreign governments had allowed B-52 basing only under limited conditions because of the B-52s' link with nuclear weapons and their widely publicized role in the Vietnam War. These restrictions and the concerns that drove them proved resistant to change. General Schwarzkopf ranked the employment of B-52s an important element of the attacks on Iraqi forces, but when the air campaign began, the only B-52s stationed close to the theater were the 20 aircraft on the British-controlled island of Diego Garcia in the Indian Ocean, approximately 3,000 miles from the target areas.

During Desert Shield, the U.S. Air Force proposed B-52 basing in several countries, including Egypt, Saudi Arabia, and Spain, but no moves took place until the air campaign began. It is unclear who was more reluctant: the potential host governments or American officials who did not wish to press them on a potentially delicate issue at a time when weightier matters appeared to be at stake. Certainly the base in Saudi Arabia proposed for B-52 basing raised such concerns, given that Iraq had already accused Saudi Arabia of allowing Westerners to desecrate the Muslim holy places. To minimize the problem, B-52s deployed to their wartime operating bases, but with no publicity and only *after* the air campaign began. Some B-52s flying from Diego Garcia or Wurtsmith AFB in the United States landed in the theater after the initial attacks of the air campaign. Soon after, B-52s deployed to Moron Air Base in Spain and

later to Fairford Air Base in Great Britain and flew bombing missions from those locations.¹

While many NATO countries committed their support to the Coalition, Turkey, owing to its unique position as the only NATO country bordering Iraq, played a particularly key role and ran great political risks. Contemplating the prospect of operations from Turkey and increased access by U.S. forces to Turkish air bases, the Turkish government had to weigh carefully its relationships in the Middle East. At the outset of the crisis in August 1990, U.S. Air Force combat aircraft had deployed to Incirlik Air Base on routine exercise deployments. The United States sought to augment this force with additional aircraft from Europe, creating an organization called Proven Force to undertake combat operations against Iraq from the north. To gain permission for combat missions from Turkey and to increase the number of U.S. tactical aircraft deployed there required careful negotiations with the Turkish government. The U.S.-Turkish Defense and Economic Cooperation Agreement authorized a maximum of forty-eight tactical aircraft, a number the United States sought to double temporarily to ninety-six.² Turkish public and governmental opinion diverged over the country's proper role in the Gulf crisis. All agreed on the need for defensive precautions against an Iraqi attack, but many opposed the use of Turkish soil for waging offensive war. During the fall of 1990, both the Turkish Defense Minister and the Chief of Turkey's General Staff resigned over the matter. The final agreement permitting the use of Turkish air bases came to fruition literally hours before the opening of the air campaign; on 17 January, the Turkish Parliament approved offensive use of their air bases by the aircraft of Proven Force. The additional aircraft along with the Proven Force commander, arrived at Incirlik that same day; American aircraft began flying combat missions that night.³

¹(S) *History of the Strategic Air Command 1 Jan - 31 Dec 1990, Vol I* (Office of the Historian, Strategic Air Command, 1992), pp 230, 240-41.

²(NATO/S) Jerome E. Schroeder and Thomas L. Raab, *History of Joint Task Force Proven Force* (Hq, USAFE History Office, 1991), pp 23-4.

³Sorties were canceled the next day while the Turkish officials reexamined what they had just signed up to, but operations then restarted less than a day later, with no further interruptions for the remainder of the war. *Ibid.* pp 30-3.

A further complication arose from the use of the NATO Airborne Warning and Control System (AWACS) aircraft, also stationed at Incirlik. Since NATO as an organization played no official role in the Persian Gulf War (although member nations did), these aircraft could operate in the defense of Turkey but not in support of offensive operations against Iraq. To avoid the problem, the United States deployed an American AWACS in addition to the NATO aircraft. The NATO plane provided defensive surveillance, the U.S. AWACS, offensive command and control.⁴

Excluding Israel from basing or overflight arrangements defused one potential political problem for the Coalition, the linking of the confrontation with Iraq to the Arab-Israeli conflict. Israel had no interest in participating in the war, but Iraq saw—correctly or not—an opportunity to fracture the Coalition by dragging the Israelis in, and so immediately began a series of Scud attacks against the Jewish state. The United States attempted to prevent such a situation by attacking the Iraqi fixed Scud launch sites in western Iraq on the first day of the air war. More than 1,600 Coalition strikes (and even more sorties) flew against fixed launch sites, mobile Scuds, Scud production facilities, suspected hide sites, and communications nodes, all with unknown effect. The United States also sought to gain Israeli forbearance by actively supporting Israel with Patriot missile defenses and communication links that increased warning time of the Scud launches. At the same time, the United States discouraged any move by Israel to conduct its own air strikes against Iraq.⁵ It remains unclear how close the Israelis came to retaliation for Iraqi attacks; one can only speculate about the real damage that would have been done to the Coalition by such a move. Arab Coalition members may not have reacted to an Israeli attack on Iraq in the ways that American decision-makers feared; luckily, the test never came.

⁴(S) Intvw, CMSgt Jerome E. Schroeder, USAFE History Office, with Maj Gen James L. Jamerson, Commander Joint Task Force Proven Force, 27 Mar 1991, Ramstein Air Base, Germany, GWAPS, NA 124.

⁵David Makovsky, "Of Friends and Foes," *Jerusalem Post*, 18 Jan 1992, p 14 (excerpts from U.S. News & World Report Staff, *Triumph Without Victory: The Unreported History of the Persian Gulf War*).

Iran, which could have affected Coalition air operations most directly, did not in fact play a substantial role militarily during the crisis, but gained much politically. During Desert Shield, Saddam Hussein attempted to secure his eastern flank by allowing territorial concessions to the enemy that Iraq had vanquished only two years before. During the war, Iranian action indicating potential hostility or military support for Iraq would have kept aircraft carriers out of the Gulf, thereby greatly increasing their aircraft range to the target (adding to the already high demand for air refueling tankers). Also, such action would have made air operations close to the Iranian border, particularly in the Basra area, a subject of great concern. Iran, recognizing immediately the political advantages accruing from having the Coalition dispose of its ten-year nemesis, created no such difficulties. Instead, it provided a service to the Coalition (and even more so to its own interests) by remaining strictly neutral and interned the Iraqi aircraft that fled to Iran beginning in late January. Iran reaped additional benefits by retaining those aircraft, and even more from the military devastation wreaked on its chief rival for dominance in the Persian Gulf region.

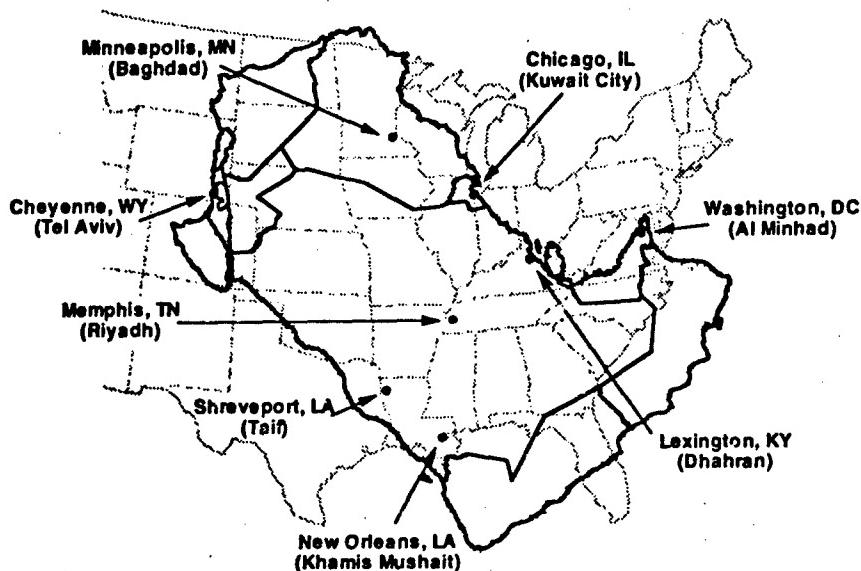
Physical Factors

Distances, Terrain, and Weather

To employ Coalition air power against Iraq, aircraft had to fly extended distances and operate in conjunction with other aircraft from distant bases. The flight distances from the air bases to the target areas (see map) made aerial refueling—often multiple refueling—a nearly standard part of most combat missions. The closest land or carrier basing put aircraft 175 or more miles from the nearest targets in the Kuwait theater and more than triple that distance for targets in the Baghdad region. The bulk of the combat aircraft flew from bases in southern Saudi Arabia and the coastal Gulf states; for them and the Red Sea carrier aircraft, the targets were 700 to 1,000 miles away, well beyond the unrefueled combat radius of most aircraft. Proven Force attacked most of the targets in northern Iraq, but even these aircraft, which could not overfly Syria and therefore had to fly a dog leg around it, still traveled 600 miles or more to their targets. For the B-52s, the 700-mile distances for the aircraft based in the theater were the shortest; most of the

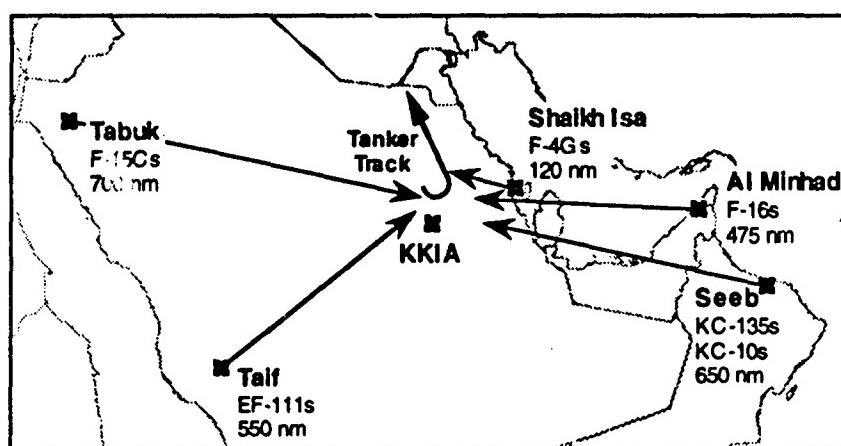
B-52s traveled 2,900 or more miles from Diego Garcia, Moron Air Base (Spain) or Fairford Air Base (Great Britain).

Figure 27
Relative Distances in the Area of Operation



Flying from the Saudi and other Gulf state bases meant coordination and flight rendezvous with other aircraft from bases hundreds of miles apart. From Al Minhad in the United Arab Emirates, for example, F16s would typically join in a "package" of aircraft that could include F-15Cs from Tabuk in Saudi Arabia, EF-111s from Taif in Saudi Arabia, F-4Gs from Shaikh Isa in Bahrain, and KC-135s from Seeb, Oman, along with airborne control aircraft from several additional bases. While the above example names only U.S. Air Force aircraft, packages also included Navy, Marine, and other Coalition aircraft. The complexity of the coordination and the distances involved added to the scale of operations: the package cited above might involve twenty-four to thirty-six aircraft, and dozens of such packages flew every day.

Figure 28
Formation of a "Package" for Attacks into Iraq



The basic information for the flights arrived in the daily air tasking order; delays in publishing the order or late changes forced the flying units to rely on advance information received by telephone from planners at Riyadh. The air tasking order provided the targets and timing, but the mission commander still determined the routing, tactics, and other procedures and passed this information by secure telephone to the other units in the package. Navy flight crews on board aircraft carriers in the Red Sea or Persian Gulf faced a more difficult time getting the air tasking orders. Because of equipment incompatibility with Air Force secure communication devices, the tasking order documents were flown daily to the ships. Navy crews had an easier time coordinating the flights, however, since most of the aircraft from the same ship flew together.

In contrast to the complex communications arrangements of Central Command forced by the physical dispersion of its air bases, Proven Force crews at Incirlik, Turkey, faced a much simpler task. Here, the United States Air Forces in Europe had set up a composite wing organization composed of attack, air defense, and support aircraft from eight different flying units, so that the crews could plan the missions and discuss the

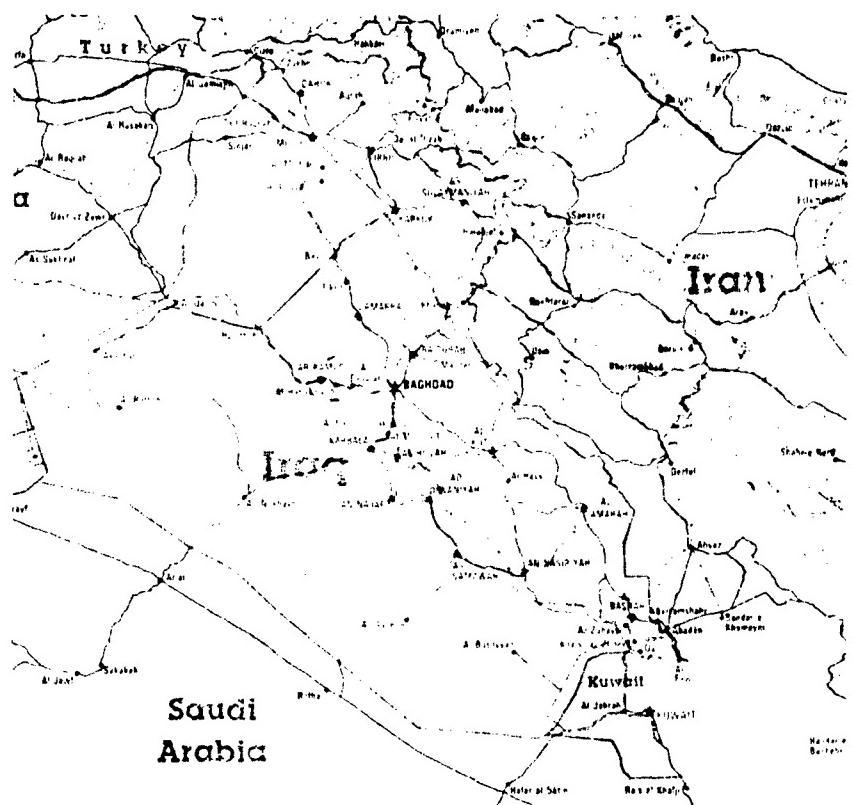
results face-to-face in the same room, minimizing even the need for a published air tasking order.

Terrain in the target areas presented several advantages to the attacking aircraft but posed some problems as well. The flat, undifferentiated desert terrain of the Kuwait theater made visual orientation of targets by the attack aircraft quite difficult. The combination of the high altitudes flown by the attacking aircraft, the Iraqi use of decoys and camouflage, obscuring smoke, and conditions of blowing sand (and, particularly late in the war, smoke from oil fires) complicated both visual and infrared observation of vehicles and equipment. Aircrews in aircraft equipped with infrared targeting and navigation systems discovered that they could pick out vehicles effectively at night, and particularly in the early evening, since the different cooling rates of the sand and the metals of Iraqi vehicles made the vehicles stand out at night as beacons in the infrared targeting systems of Air Force and Navy aircraft.

The geography of Iraq dictated the paths of resupply to the Kuwait theater. Supply route from the north had to cross a series of bridges over the Euphrates or Tigris Rivers and transit a network of roads that merged as they approached the city of Al Basra. These bridges and roads provided excellent targets for air interdiction operations. At the same time, the open and rather hard-packed ground allowed the resupply effort to bypass damaged sections of roads and many bridges. Perhaps the most dominant terrain feature of the Kuwait theater was the large marshy lake, the Hawr al Hammar, beginning west of Al Basra and extending further west towards An Nasiriyah. This lake formed a northern barrier for the Iraqi army in the theater, passable at one main causeway. When the Coalition ground forces attacked from the south and west, the Iraqi army's only path of retreat lay north over this causeway or eastward to the damaged and destroyed bridges over the canal west of Al Basra.⁶ On 27 February, the last day of the war, the area bounded by Coalition forces, the Hawr al Hammar, and the canal became the Basra pocket. This area contained most of the Iraqi forces that had not fled the theater earlier or fallen prisoner to the Coalition.

⁶See Chapter 3 for discussions of the attacks on the bridges in Iraq and the retreat of the Iraqi army to Al Basra.

Figure 29
Map of Iraq and Kuwait



Weather was another of the physical conditions that came to frustrate Coalition operations. Desert Storm air operations encountered the worst January and February weather reported in the theater in 14 years, conditions that hampered bombing effectiveness considerably. Analysis by the Air Weather Service determined that the Coalition encountered cloud ceilings below 10,000 feet over Baghdad and Kuwait roughly twice as

frequently as historical climatology would have indicated.⁷ Particularly in the early days of the air war, as many as half of the sorties did not attack or missed their assigned targets because of poor weather. Some aircraft thus had to employ less accurate radar-aimed bomb releases through the clouds; other aircraft, such as A-10s and AV-8Bs, returned with their weapons or did not take off at all. Laser-guided bombs could not be guided if the target lay beneath fog or clouds. On the second and third days of the air war, more than half of the F-117 flights were unsuccessful or canceled because of low clouds over Baghdad; on the following 2 days in the Kuwait theater, A-10s that normally flew a total of over 200 sorties a day successfully flew a 2-day total of only 75.⁸ Weather conditions did not remain as severe for the entire war, but the adverse conditions for the first 10 days, and again during most of the ground war, created a vivid impression on flight crews.

The weather encountered during the air war proved unexpectedly bad, not just because it differed so much from the climatological record but because it differed so sharply from the weather of fall 1990. During training for the air campaign, skies remained clear for weeks at a time, and even visibility restrictions from blowing sand were absent in the operating areas.⁹ The briefings on the air campaign included a depiction of the anticipated January-February weather patterns, but the expected patterns typically suggested two days of a passing weather front, followed by three to five days of clear skies. Instead, the weather fronts came and stayed, bringing more fog and lower ceilings than expected. Moreover, the decision to bomb from medium altitude multiplied the impact of the weather, for a target visible to an aircraft at 1,000 feet altitude might escape observation at 10,000 feet.

⁷Air Weather Service, Operations Desert Shield/Desert Storm, Report No. 2, "An Analysis of AWS Support to Operations Desert Shield/Desert Storm," 6 Dec 1991, p 125, GWAPS, NA 76. (Henceforth AWS Report 2.)

⁸F-117 Summary Data, GWAPS Missions Database: 23/354 TFW(P), "Combat Chronology," 20 and 21 Jan 1991, AFHRA 00885046-51.

⁹USAF Environmental Technical Application Center Technical Note 92/003, "Gulf War Weather," pp 2-1 to 2-2-57.

Two final observations are warranted on the weather encountered. First, while unusually severe for the region, the weather was nonetheless superior to conditions in those same months in most other parts of the northern hemisphere. Flying over Frankfurt in Germany or Hanoi in Vietnam, for instance, pilots would have experienced low ceilings twice as frequently as those actually encountered in the Persian Gulf region. In other words, visual, medium-altitude bombing tactics would have proven virtually impossible during a typical European winter or Southeast Asia monsoon, during which cloud ceilings at or below 10,000 feet occur 80 or 90 percent of the time.¹⁰ Second, it is not clear that the Coalition actually encountered unusually poor weather. Planners may have simply been excessively optimistic because of the poor quality of climatological data for the region. U.S. forecasters at several locations in the theater noted disparities between their procedures for recording weather observations and those of the local meteorologists, particularly in reporting ceiling and visibility. The U.S. forecasters, while having insufficient time to make a thorough evaluation, began to doubt that the Persian Gulf data they had used rested on accurate assessments of the last 14 years.¹¹

The Air Bases

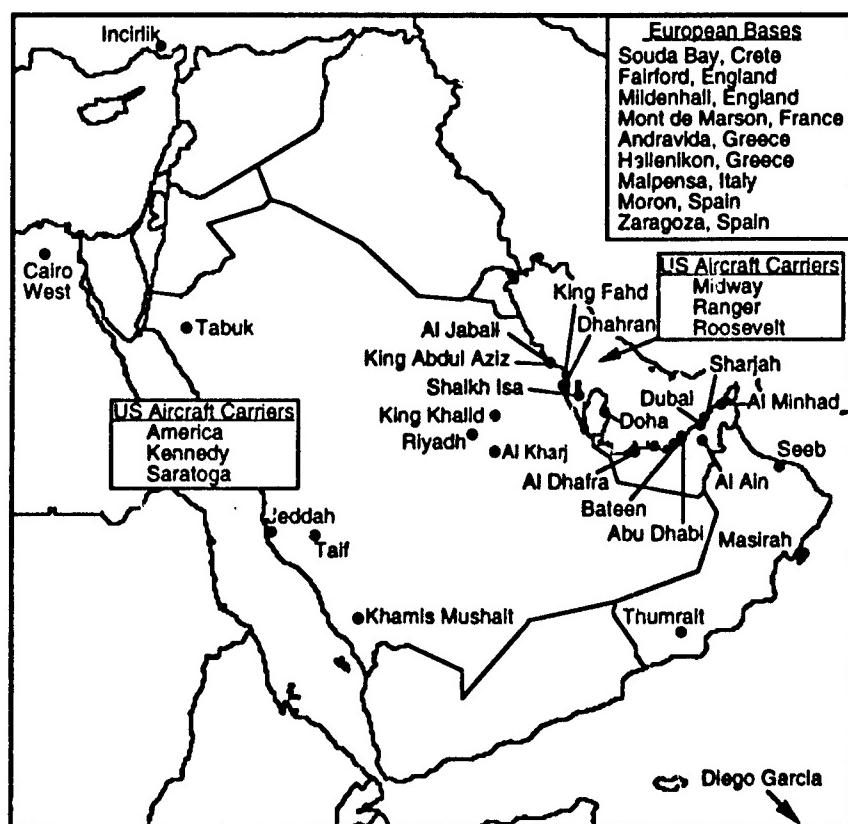
The quality of bases used for Desert Storm varied considerably within and among countries. Saudi Arabia is the most prominent case in point. The Saudis had superb air bases, some finished, occupied, and with excess capacity, and some incomplete—that is, possessing runways and ramps but little else. The facilities occupied by the Coalition air forces varied from those at Khamis Mushait, which had ample aircraft shelters and modern living and working conditions, to those at Al Kharj, a site still under construction. Al Kharj had only runways and taxiways, and the nearest source of water was twelve miles away. Even with excess capacity, however, the bases could not handle the size of the air forces deployed there during the Gulf War, particularly after the second phase of deployments in November 1990, without additional engineering support and temporary construction.

¹⁰ USAF Environmental Technical Applications Center Study, "Comparison of Germany, Viet Nam Climatology to Persian Gulf Climatology and Desert Storm-Jan-Mar," 19 May 1992, Capt R.P. Arnold and TSgt R.C. Bonam.

¹¹ Air Weather Service Report 2, p 117-118, 123.

The Saudi bases, however, were just part of the story. The United States operations plan that served as the basis for the original deployment directed flying units to fourteen air bases in five countries. U.S. aircraft actually operated out of twenty-three bases, eleven in Saudi Arabia. The remainder were in the other Gulf states, which lacked the Saudi base infrastructure to support air operations.

Figure 30
**Map of Region Depicting Major Air Bases used by
Coalition Air Forces during Desert Storm**



The Saudi air bases owed much to long-standing security assistance relations with the United States. Dhahran served during World War II as a resupply point for U.S. forces in Asia, and the U.S. Army Corps of Engineers rebuilt Dhahran Airfield in 1956. In the 1960s and 1970s, U.S. Army and Air Force engineers designed and constructed several more bases, including the major bases Taif, King Khalid Military City, and Khamis Mushait. These bases and support facilities, which accounted for three quarters of U.S. military sales to Saudi Arabia over the past forty years, provided the needed infrastructure to help absorb a deployment of the size and speed of Desert Shield.¹²

The American military organized base support on the run. The Desert Shield deployment was not only larger than anticipated, but almost none of the units (two percent) deployed to a base originally assigned in the operations plan. Gen. Walter E. Boomer, Commander of the First Marine Expeditionary Force, commented that the deployment seemed to be "first come, first served" in acquiring airfields.¹³ Most bases required a vast array of services for the early deploying units, which arrived ahead of most of their logistical support—a calculated risk assumed by CENTCOM in the interest of deterring an early Iraqi attack. Logistical personnel scrambled to improve functions such as fire fighting, feeding arrangements, water purification, sanitation, fuel supply, and secure communications, all of which created vulnerabilities or could have impeded operations. Fortunately, the bases could expand, and at many locations local businesses could provide rental equipment or services to ameliorate shortages. In some cases, Coalition forces found it necessary to build the bases almost from scratch. In less than two months, for example, Al Kharj changed from a base with no buildings to one with tents, dining halls, hangar space, a hospital, electric power generators, and other services to support a population of almost 5,000 Air Force personnel.

¹²Remarks by Hon Henry S. Rowen, ASD (ISA), at the Defense Institute of Security Assistance Management's (DISAM) Fourth International Military Assistance Symposium, 17 Jul 1991. Excerpted from *DISAM Journal*, Vol 13, No. 4, Summer 1991, p 4.

¹³Lt Gen Walter E. Boomer, "Special Trust and Confidence Among the Trail-Breakers," *U.S. Naval Institute Proceedings*, Nov 1991, p 47.

The rapid growth from August 1990 to January 1991 did not happen, of course, without shortcuts in procedures and turbulence on the bases themselves. People, for lack of quarters, slept in hallways and in hangars; pilots flew extended missions without adequate rest; aircraft were parked in open rows without protection; tent cities adjoined munitions storage areas; and the leadership at each base cut whatever deals they could with local merchants for food, transportation, and other services. It was only after months of such improvisation that more orderly routines and support structures came to the bases.

Proven Force operations at Incirlik faced different circumstances. Incirlik had long served as a host base for U.S. Air Force operations and in addition to Air Force personnel housed more than 2,000 Air Force family members and other U.S. civilians. Because of the Scud and terrorist threats in the area during the Gulf conflict, the Air Force evacuated these people between 15 and 21 January, providing room for more than 3,000 additional deploying forces. Thus, although a tent city arose to house many of the personnel, maintenance and support facilities and office space were already in place and operating.

Base security personnel alone could not protect the air bases. The principal threat in August and September was expected to come from an Iraqi army attack south into Saudi Arabia, with the most dangerous thrust along the coast to the oil fields. Early-arriving U.S. Army and Marine forces moved in to hold the key enclaves around Al Jubayl and Dhahran, from which the Coalition aircraft would launch to meet the attack. By September, the threat of a direct attack by the Iraqi Army had receded, but the danger of terrorism remained a primary concern throughout the deployment period and the war. Both Generals Schwarzkopf and Horner pushed to get the American forces out of the communities, particularly high-rise hotels, and onto the bases in dispersed quarters as rapidly as possible. When the air campaign began, the U.S. forces on Dhahran Air Base even moved from base facilities to bunkers and makeshift quarters near the aircraft. At peak strength, Air Force security police numbered only 4,500 throughout the theater. On the whole, they had to confine their activities to providing security within base perimeters and limited exterior screening but not to defense of the base itself.

Most often, security outside the base remained with the host nation's security forces, and this proved effective. Despite Iraqi threats to unleash terrorists against U.S. forces in the theater and around the world, only one confirmed terrorist incident occurred in the theater during the entire period of the deployment: shots were fired at a bus carrying American Servicemen near Jeddah Air Base, inflicting only minor injuries. Saudi security forces apprehended four Palestinians and two Yemeni.¹⁴ The efficiency of Saudi police work, lack of preparation and perhaps coordination by the Iraqis and their allies, and the protection offered by distance secured the bases from attack. This proved extremely fortunate, since many bases had little in the way of passive protection--bunkers for ammunition and fuel, extensive perimeter defenses, and aircraft shelters.

A final threat to the bases came from Scud missiles, possibly armed with chemical warheads. Launched from Iraq, they could reach bases on the Arabian Peninsula-Bahrain, Dhahran, and Riyadh--and Incirlik Air Base in Turkey. Patriot missile batteries protected the bases, but a Scud alert meant that military personnel had to take shelter and don gas masks and other protective gear. Multiple Scud alerts dulled the reactions of personnel to these measures, but the threat of a Scud-delivered chemical weapons attack persisted, a threat that Central Command took with increasing seriousness as the war went on and Iraq's position became more desperate.

Base personnel had minimal contact with the local population, both for security reasons and, particularly in Saudi Arabia, to ease Saudi fears of disruptive Western influence on their culture. Central Command prohibited possession of alcohol or sexually explicit material, set off-base dress codes for men and women, and did not allow chaplains to wear religious insignia off base. While the Saudis were sensitive to the actions of U.S. personnel off base, they made no moves to curb religious services on U.S. sites, and chaplains conducted Catholic, Protestant, and Jewish services. Easing the relationship was the extensive Saudi experience in coping with large numbers of Westerners working on vast development projects in or near the oil fields. The physical isolation of most bases also helped.

¹⁴Air Force Office of Special Investigation Briefing, nd, presented to OSI Commanders Conference 1991, p 3; USCENTAF/SP Battle Cell Log, 3 Feb 1991.

Life on the bases meant a combination of hectic round-the-clock schedules, boredom on off-duty time, and Scud alerts after the air campaign began. As the supply system became established, recreational equipment arrived, base stores opened, and local commanders pushed to improve living conditions. Bases could operate on more normal routines, but with many restrictions. Because the objectives and time of the deployment were uncertain initially, Central Command in October 1990 began planning for rotations of forces after six months; the command abandoned that policy within several weeks when the second deployment was announced. Everyone would remain for the duration.

Life for the aircrews during the air campaign involved little beyond sleep and the flight schedule. Crew routines varied with the type of aircraft they flew. Fighter and support aircraft missions often lasted five to ten hours, and these crews flew every day (or night), with an occasional day off. Crews for longer missions flew every other day. For example, crews on B-52 missions from Diego Garcia or from bases in Europe spent fifteen hours or more in the air; AWACS or JSTARS aircraft missions lasted more than twelve hours. And flight times did not count the hours of preparation and debriefing on either side of the missions. Additional crews augmented the flying squadrons, but commanders of every type of aircraft unit cited a need for greater crew manning to support the number of sorties flown daily. Flight surgeons cited fatigue as the most pervasive problem facing aircrews, attributing at least two noncombat fatalities to it. A study of Tactical Air Command crew members reported that two-thirds used medical stimulants and sedatives during the deployment, and fifty-seven percent did so during the war.¹⁵

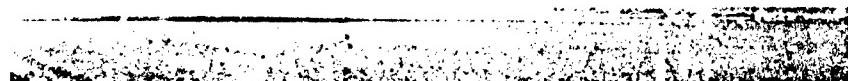
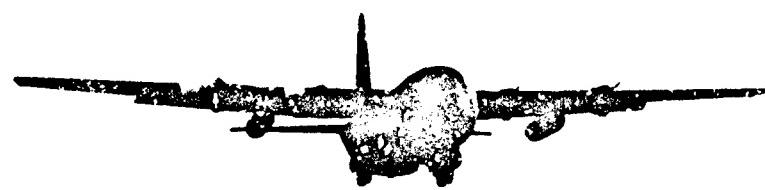
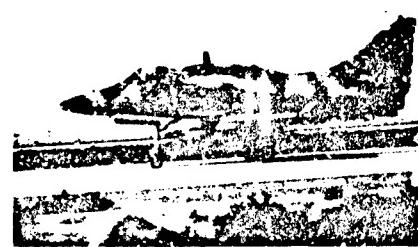
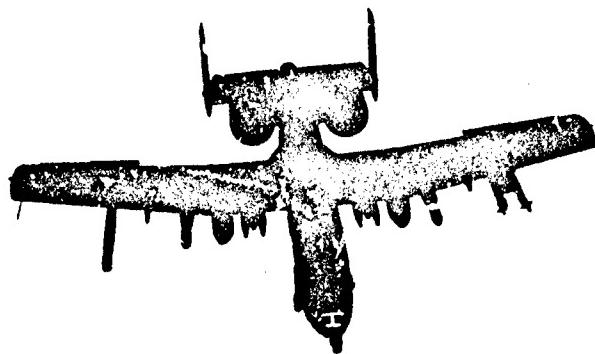
Theater Conditions and the Preparation of Air Power

As noted, the overall political and physical conditions of the theater proved uniquely suitable to the deployment and application of air power. Even the great distances involved worked to the Coalition's benefit: only Iraqi Scuds could hit Coalition bases, and not all of them. Once the war began, Coalition aircraft could pummel the enemy without serious fear of

¹⁵Rpt. HQ USAF/SGPA, *Aerospace Medicine: Consolidated After-Action Report—Desert Shield/Desert Storm*, Jan 1992.

disruption from enemy ground forces, artillery, surface-to-air missiles, or aircraft. The desert has always proven the most favorable environment for the application of air power, and in this war it afforded the additional important benefit of removing most concerns about collateral damage throughout much of the Kuwait theater. And despite the deficiencies of some the bare bases inhabited by Coalition forces, never has an expeditionary force deployed to a region so well-endowed with air and sea ports,¹⁶ first-class roads, and a wealthy local economy to provide various support services. Above all, Coalition forces benefitted from the passivity of an opponent: who had, at least in theory, the capability to make the deployment a harrowing and costly military ordeal, rather than the exhausting and chaotic but nonetheless peaceful operation it was.

¹⁶Of these Dhahran and the associated port at Ad Dammam were by far the most important, serving as they did as the main points of debarkation for both air- and sealift. An Iraqi attack on the port and associated air fields could have complicated the deployment tremendously.



What were the Instruments of Air Power?

Removing Iraqi forces from Kuwait required the efforts of many nations, but the United States provided the bulk of the military resources, air concepts for their employment, and the command and control structure to implement those concepts. These truths apply to the air campaign as well as to all other aspects of the war. On closer study, it becomes apparent that in some areas the American effort constituted close to one hundred percent of the whole; in others considerably less. Moreover, the American armed Services provided different kinds of air power, reflecting practices, concerns, and equipment characterizing each of the individual Services. The following pages examine the composition of these forces to provide the reader with a better understanding of instruments of air power and their complexity.

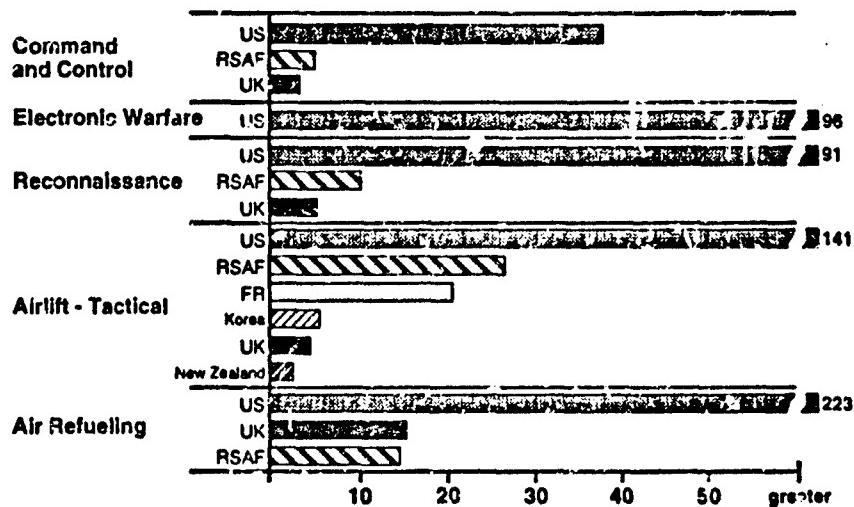
From outside the Middle East, four countries besides the United States (Great Britain, France, Canada, and Italy) sent combat flying units. Several more (South Korea, New Zealand, and Argentina) provided a nominal number of transport aircraft (C-130s) and crews and others (the Netherlands, Belgium, Luxembourg, and Germany) sent air units to Turkey as part of the NATO defense of that country against Iraq but not to participate in Desert Storm. Gulf state air forces were from Saudi Arabia, Kuwait, Bahrain, Qatar, and the United Arab Emirates.¹ U.S. air assets were spread among the Air Force, Navy, Army, and Marine Corps, including Army and Air Force Special Operations Command aircraft, which flew more than 1,000 fixed- and rotary-wing sorties during Desert Storm. Coalition air power also included cruise missiles, drones for reconnaissance and decoys, and satellites for communications, reconnaissance, and weather observation. Elements of that air power moved the forces to the region, reconnoitered the targets areas, controlled the employment of air forces, defeated the Iraqi air force in the air and on the

¹Plus, Japan, S. Korea, Kuwait, and Italy donated (paid the cost of) a total of 200 airlift flights into Saudi Arabia.

ground, and struck targets throughout Iraq and Kuwait. This chapter discusses each of these elements.

American crews flew more than eighty-five percent of the sorties during the war. Many countries supplied air-to-air fighters, air-to-ground attack aircraft, and cargo aircraft, but the United States provided all or almost all of the Coalition's command and control systems, electronic warfare aircraft, heavy bombers, cruise missiles, and stealth capability. Overall, the key contributions of the United States came not just in numbers of systems but in *capabilities* of the various elements of air power, some based on *quality* (e.g., stealth), others on a *quantity* so great that it brought a quality of its own (e.g., aerial refueling and airlift) (See Figure 31).

Figure 31
Coalition Aircraft Totals in Key Elements of Air Power Support



An array of high-technology American systems gave the Coalition a devastating advantage. The F-117s, Tomahawk missiles, and conventional air-launched cruise missiles delivered conventional warheads with great precision, unchecked by Iraqi defenses. Airborne warning and control aircraft monitored Iraqi and Coalition flight activity, and the joint strate-

gic airborne reconnaissance system (JSTARS) aircraft monitored and targeted Iraqi ground forces throughout the Kuwait theater. In addition, satellites and airborne platforms provided communications, precise navigation, and reconnaissance information to air and ground forces. But it was the *combination* of U.S. capabilities, not all of them based on advanced technologies, that made Coalition air power so predominant. F-111s, A-6s, and thirty-year-old B-52s, for example, took part in air strikes, effectively using advanced technology weapons as well as unguided bombs. To counter their vulnerability to Iraqi defenses, Coalition aircraft flew into the heavily defended areas of Iraq escorted by F-4Gs, EA-6Bs, or A-7s, firing radar-homing missiles to destroy the defenses and by EF-111s or EA-6Bs to jam Iraqi radars. The success of the aerial attacks also depended on the ability to mass formations of aircraft, made possible by an extensive network of aerial refueling KC-135 aircraft. High-technology systems played a crucial role, but just as crucial was the ability to employ nearly 200 tankers at a time, organize and maneuver large attack formations, stage large airlifts routinely, and conduct continuous aircraft carrier flight operations—all based on an underpinning of intense and realistic training. These American air power capabilities cannot easily be expressed in numbers.

Coalition air power may be depicted in several ways. Table 5 gives one common measure, the number of sorties flown by type of aircraft during Desert Storm. Any one measure can only tell part of the story, however. Sortie counts do not include the space systems constantly in use or the hundreds of helicopters attached to ground and naval forces. The depiction of sorties flown gives an indication of the weight of effort by each country but does not differentiate an A-4 sortie of 300 miles carrying five 500-pound bombs from a B-52 sortie of more than 3,000 miles carrying fifty 500-pound bombs. The contributions to air power of air-to-ground sorties are captured in the January-February statistics. However, those statistics do not reflect the total contributions to air power made by air refueling and airlift aircraft during Desert Shield. The statistical compendium of this Survey presents as many measures of air power as possible; this chapter can only focus on each air power element in its own terms, with only brief mention of other comparative measures.

Table 5
Total Sorties by U.S. Service/Allied Country by Aircraft Type

Service	Aircraft Type	Flown	Service	Aircraft Type	Flown
USAF	A-10	8,084	USSOCENT	AC-130	104
USAF	B-52	1,741	USSOCENT	AH-6	3
USAF	C-12	8	USSOCENT	C-130	13
USAF	C-130	13,971	USSOCENT	CH-47	14
USAF	C-141	1,766	USSOCENT	EC-130	155
USAF	C-21	256	USSOCENT	HC-130	107
USAF	C-29	20	USSOCENT	HH-3	63
USAF	C-5	740	USSOCENT	HH-3E	112
USAF	C-9	64	USSOCENT	HH-60	9
USAF	E-3	379	USSOCENT	MC-130	84
USAF	E-6	42	USSOCENT	MH-3	19
USAF	EC-30	450	USSOCENT	MH-47	2
USAF	EC-135	24	USSOCENT	MH-53	282
USAF	EF-111	1,105	USSOCENT	MH-6	1
USAF	F-111E	458	USSOCENT	MH-60	284
USAF	F-111F	2,423	USSOCENT	UH-60	10
USAF	F-117	1,299	Total		1,262
USAF	F-15C	5,685			
USAF	F-15E	2,172			
USAF	F-16	13,087			
USAF	F-4E	4	USN	A-6	4,824
USAF	F-4G	2,683	USN	A-7	737
USAF	KC-10	1,465	USN	E-2C	1,163
USAF	KC-135	9,559	USN	EA-6B	1,126
USAF	OA-10	660	USN	F-14	4,005
USAF	EP-3	4	USN	FA-18	4,449
USAF	RC-135	197	USN	P-3	23
USAF	RF-4	719	USN	S-3B	1,674
USAF	RF-4C	103	USN	TALAM	282
USAF	TR-1	89	Total		18,303
USAF	U-2	149			
Total		69,406			
			USA	C-12	183
			USA	C-23	3
USMC	A-6	795	USA	OV-10	.51
USMC	AV-8	3,359	USA	WC-12	216
USMC	C-12	9	USA	RJ-21	242
USMC	EA-6B	504	USA	RV-1D	111
USMC	F/A-18	4,936	Total		916
USMC	KC-130	598			
USMC	OV-10	482	CRAF	CRAF	800
Total		10,683	Total		800

Table 5 (Continued)
Total Sorties by U.S. Service/Allied Country by Aircraft Type

Service	Aircraft Type	Flown	Service	Aircraft Type	Flown
Saudi Arabia	Tornado/ADV	451	Canada	B-707	163
Saudi Arabia	BAE-125	110	Canada	C-130	124
Saudi Arabia	C-130	1,606	Canada	CC-144	54
Saudi Arabia	E-3	303	Canada	CF-18	961
Saudi Arabia	F-15C	2,088	Total		1,302
Saudi Arabia	F-5	1,129			
Saudi Arabia	H-212	113			
Saudi Arabia	Tornado/IDS	667			
Saudi Arabia	KC-130	267	Kuwait	A-4	651
Saudi Arabia	RF-5	118	Kuwait	F-1	129
Total		6,852	Total		780
France	C-130	271	Bahrain	F-16	166
France	C-160	582	Bahrain	F-5	122
France	F1-CR	92	Bahrain	H-212	5
France	Gabriel	4	Total		293
France	Jaguar	571			
France	KC-135	223			
France	M-20	2			
France	M2000	512	Italy	G-222	13
France	SA-330	1	Italy	Tornado	224
Total		2,258	Total		237
UK	BN2T	35			
UK	BN1S	517	UAE	C-130	35
UK	Buccaneer	226	UAE	C-212	10
UK	C-130	832	UAE	M2000	64
UK	F-3	705	Total		109
UK	Tornado/GR-1	1,644			
UK	Jaguar	600			
UK	Nimrod	147			
UK	Tristar	75			
UK	VC-10	359	Qatar	Alpha	2
UK	VCTR	277	Qatar	F-1	41
Total		5,417	Total		43

Source: Composite Sorties Database

Airlift

The airlift that brought the forces to the region, along with the supplies to sustain them, was the greatest such airlift in history. On the basis of a common measure for airlift capacity, millions of ton-miles per day (MTM—the product of aircraft cargo weight in tons and the distance flown), Desert Shield/Desert Storm activity far surpassed earlier airlifts.²

Peak period of Desert Shield/Desert Storm: 17 MTM/day

1973 airlift to Israel during Arab-Israeli War: 4.4 MTM/day

Operation Just Cause, to Panama, 1989: 2.0 MTM/day

Berlin airlift, 1948-1949: 1.7 MTM/day

"Hump" airlift of WW II: .9 MTM/day

The size of the effort is even more impressive considering the short-term nature of the next two largest airlifts compared with the Desert Shield and Desert Storm effort of over 9 months.

C-5s, C-141s, and commercial cargo and passenger aircraft mobilized for military service as part of the Civil Reserve Air Fleet (CRAF) carried out the U.S. strategic, or intertheater, airlift.³ The C-141s flew most of the missions (fifty-three percent), the C-5s carried the most cargo (forty-two percent), and the CRAF aircraft carried most of the passengers (sixty-four percent). From bases in the United States, these aircraft flew to air bases in Europe in transit to bases in the Southwest Asia theater. European bases served as both stopover points and terminals; Rhein-Main in Germany and Torrejon in Spain saw the heaviest use (twenty-seven and

²Brsg. Hq USAF/XOXWG, "Logistics in the Air Power Campaign," 16 May 1991, GWAPS, NA 584B.

³The Civil Reserve Air Fleet consists of civil aircraft committed to augmenting the Military Airlift Command fleet in certain emergency conditions. The aircraft are mobilized in stages, or increments, based on Presidential order. Since institution of the program in 1952, however, CRAF mobilization had never been invoked before Desert Shield.

forty-four percent, respectively, of the total traffic). In the theater, Dhahran in Saudi Arabia served as the main terminus; this base alone handled half of the arriving traffic—during December 1990, forty cargo and passenger aircraft arrived every day.⁴ The strategic airlift aircraft carried nearly all the people and more than five percent of the cargo shipped to the theater (approximately fifteen percent if fuel is excluded from the total cargo figures).

Aerial refueling tankers, KC-10s and KC-135s [assigned to Strategic Air Command (SAC)], also took part in the airlift. While employed on refueling missions to the theater, these aircraft brought both their own and other units' personnel and support equipment; in this way, SAC became relatively self-sufficient in its aircraft deployment.⁵ The plans called for 20 KC-10s to serve strictly as cargo aircraft, but the need for aerial refueling sorties placed a particularly heavy demand on the tanker fleet. Ultimately, SAC supported this exclusive airlift requirement partially and reluctantly. The KC-10s flew 379 such cargo-only missions from August 1990 through January 1991.⁶

The entire strategic airlift fleet worked steadily throughout the deployment period, with two peak periods: during the initial response in August-September 1990 and again in December, after the order for the second stage of deployments—a surge that lasted through the end of Desert Storm. The C-5s and C-141s curtailed all other commitments but often ran short of air crews, particularly in the early days of the crisis before the activation of crews from the Reserves. Military Airlift Command (MAC) estimated, in fact, that its crew force would run out of allowable flying hours by the end of August, when the Reserves were activated. MAC used the Reserves in peacetime regularly, but such extensive use of the Reserves was new. Approximately half of MAC's airlift flight

⁴Strategic Airlift in Operation Desert Shield and Desert Storm, p 36. Data derived from the Military Air Integrated Reporting System and recorded in rpt, John Lund and Ruth Berg, *Strategic Airlift in Operation Desert Shield and Desert Storm: An Assessment of Operational Efficiency* (Santa Monica, CA: Rand WD-5956-AF, 1992).

⁵Brg, SAC staff to GWAPS personnel, 10 Feb 1992.

⁶(S) Military Airlift Command, MAC History 1990 (Scott AFB, IL: Hq MAC/HO, 1991), p 79; (S) SAC History, pp 335-36, GWAPS *Statistical Compendium*, Table 22.

crews and maintenance personnel resided in the Reserves, and even before the crisis, at any one time approximately twenty percent of the Reserve Associate crews were flying on a regular basis.⁷

The Civil Reserve Air Fleet had been a long-standing contingency force but had never been used and needed adaptation. The first stage of CRAF augmentation, an authorization for 38 aircraft and crews, including 12 Boeing 747s, occurred on 17 August; it provided an increase of only 10 aircraft, however, since the other 28 had already begun working under contract with the airlines. The second stage, authorizing 76 more aircraft, took place on 17 January 1991, but only 9 cargo aircraft were added; the remainder were already contracted and flying.⁸ The CRAF augmentation provided a vital addition to the airlift, particularly in passenger-carrying ability, but with some attendant limitations. During the war, because of the concerns of some of the aircraft owners, CRAF aircraft could not stay on the ground at bases within range of Scud missiles during hours of darkness—a problem, since the main debarking base of Dhahran was within this range; in addition, the aircraft insurance policies specified geographical exclusion zones in which rates increased 2,000 percent, making each trip particularly expensive.⁹ An earlier activation of CRAF II, dedicated to transporting personnel (one-third of whom flew on military transports), might have eased the initial deployment.

Intratheater airlift distributed the supplies and people throughout the Arabian Peninsula after they arrived in the theater. C-130s, 149 from the U.S. Air Force (one-third of the total Air Force fleet) and smaller numbers from across other Coalition nations (Saudi Arabia, the United Kingdom,

⁷Lt Gen Vernon J. Kondra, *Operation Desert Shield-Desert Storm: The Vernon J. Kondra Notes*, 24 Aug 1990-31 May 1991, transcribed by Clayton Sneedeker, 21st Air Force Historian (McGuire AFB, NJ: 1992), pp 6-8; John Lund and Ruth Berg, *Strategic Airlift in Operation Desert Shield and Desert Storm*, pp 27, 28; (S) Ltr, MAC DCS Plans and Programs/XPX to MAC History Office, "Review of Chapter III of 1990 MAC History, Operation Desert Shield," 6 Sep 1991.

⁸MAC History, p 65; Department of Defense, *Conduct of the Persian Gulf War, Final Report to Congress*, April 1992, p 420.

⁹*Kondra Notes*, pp 84, 111, 114; *Strategic Airlift in Desert Shield and Desert Storm*, pp 22-23; Stacy Shapiro and Meg Fletcher, "War Tensions Heat Up Market: Insurers Restrict Cover for Gulf Area," *Business Insurance*, 14 Jan 1991, p 45.

France, Canada, United Arab Emirates, South Korea, New Zealand, and Argentina), bore the brunt of this work.¹⁰ These aircraft flew regular routes to all regional bases and supported large ground unit transfers within the theater. Where their routes ended, smaller transports or cargo helicopters continued the lift. The size of the theater and the number of bases made extensive intratheater airlift essential. Of the 12 reporting categories, intratheater airlift (22,064 sorties) ranked second only to interdiction (38,277 sorties) in total number of sorties flown during the war.¹¹

In addition to moving passengers, spare parts, fuel, mail, and other items, intratheater airlift accomplished tasks that road transport or communications could not. The C-130s were among the first aircraft deployed to the theater (96 had arrived by 9 September) to move the initial munitions, tents, and other support needed to stock the bases being established. The intratheater airlift aircraft not only were scheduled on the air tasking order (ATO), they physically *delivered* the ATO every day to locations without communications equipment for receiving classified information and to aircraft carriers, which did not have the equipment for receiving the ATO electronically. During Desert Storm, daily flights to Riyadh delivered film from reconnaissance aircraft and videotape from attack aircraft. When the XVIII Airborne Corps repositioned 400 miles to the west for the ground attack, C-130s flew scheduled landings at the repositioning site every 7 minutes, 24 hours a day, for nearly 14 days. During the ground war, airlifted logistics followed the ground advance, including an air drop by C-130s of more than 100 tons of food and water to the 101st Airborne Division on the Euphrates River—the large number of prisoners taken having depleted the supplies of that division.¹² This aspect of airlift, less visible than the large transportation network leading to the theater, proved no less vital to the war's smooth prosecution.

¹⁰These aircraft augmented the U.S. AC-, MC-, EC-, HC-, and KC-130s that also took part in operations.

¹¹See GWAPS *Statistical Compendium*, Table 64.

¹²Brfg by Col Maxwell C. Bailey, Commander, 317th Tactical Airlift Wing, to the Chief of Staff of the Air Force, 19 Jul 1991.

Aerial Refueling

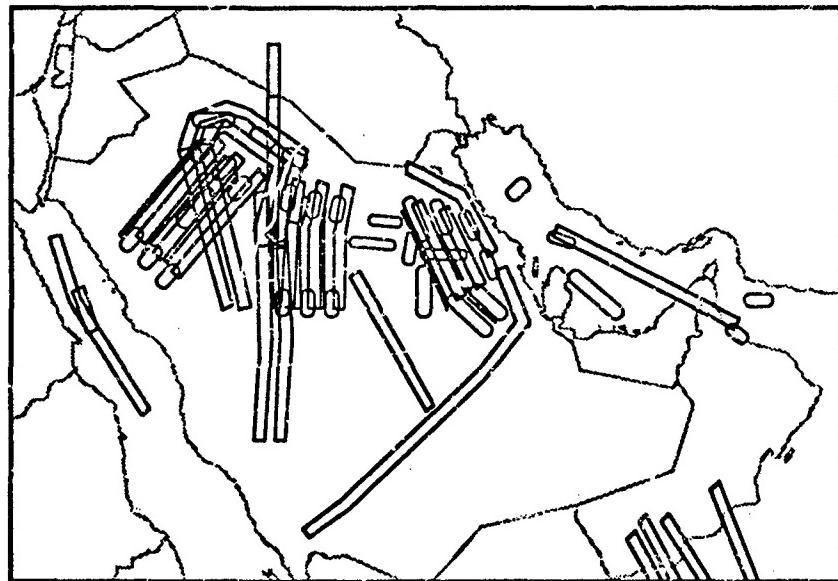
Aerial refueling facilitated two different aspects of the Gulf War: the speedy deployment of large air forces to the region, and the use of these forces in large and complex air combat operations. Five countries using twelve different types of aircraft provided this refueling capability. Participating aircraft included nearly 300 U.S. Air Force KC-10s and KC-135s—almost half of the USAF fleet. Others included 20 Marine Corps and Special Operations Command KC-130s, 16 Navy KA-6s (plus other A-6s and S-3s configured for aerial refueling), 15 British aircraft (VC-10/Victor/Tristar), 12 Saudi KE-3s/KC-130s, 6 French KC-135s, and 3 Canadian Boeing 707s. Non-U.S. tankers mainly refueled aircraft from their own nation but could refuel others and often did. All were needed, since air defense fighters and airborne control aircraft remained aloft for extended periods, and many of the attack aircraft needed to refuel on the way to the targets and again on the return leg to their bases because of the distances involved. The tanker aircraft proved a critical resource, but a heavier commitment of the U.S. fleet would not have helped; the limitation was airspace, not numbers (See Figure 32). With a daily average of 360 tanker sorties, the refueling tracks saturated the available airspace; the number of refueled aircraft is uncertain, but SAC tankers alone refueled an average of 1,433 aircraft a day.¹³ Some 60 percent of all attack sorties required air refueling. Of the total number of Desert Storm sorties by category, aerial refueling ranked third, behind airlift. U.S. aircraft accounted for 90 percent of that total, with the U.S. Air Force fleet of KC-10s and KC-135s assuming the preponderant share.

Aerial refueling capability enabled fighter squadrons and bombers to deploy nonstop from the United States to the Southwest Asia theater even loaded with armaments, more than 1,000 U.S. aircraft deployed in this way. It took nearly 100 tankers operating out of en route bases to create an Atlantic air refueling bridge and a less frequently used bridge across the Pacific. Fighter aircraft deployments from the United States to the theater traversed 6,900 nautical miles, took 15-16 hours' flying time, and required from 7 (for F-15Es) to 15 (for F-4Gs) refuelings en route. The

¹³GWAPS *Statistical Compendium*, Tables 109-113; (S) Desert Storm/Desert Shield Tanker Assessment, Hq. Strategic Air Command, Plans and Requirements (XP), 23 Sep 1991, pp 2-3, 9-3.

ability to fly nonstop enabled F-15Cs to be on alert in Saudi Arabia within a day after notification to deploy and 5 U.S. Air Force fighter squadrons to arrive in the region within 5 days.¹⁴ Similarly, aerial refueling not only extended the range of attack aircraft, it allowed massive concentrations of strikes and continuous airborne control and surveillance of battle areas.

Figure 32
**Aerial Refueling Tanker Tracks over Saudi Arabia
and Nearby Regions**



¹⁴Two aircraft carriers were also on station in the region by this time.

Command and Control

U.S. forces had almost a monopoly on airborne command and control systems, although Saudi and NATO airborne warning and control system (AWACS) aircraft performed supporting roles. Nearly half of the U.S. Air Force's AWACS fleet took part. Flying from Saudi Arabia, a contingent of eleven Air Force E-3 AWACS aircraft, flying three at a time, maintained continuous coverage of the air picture from the Red Sea to Persian Gulf throughout the war. On the flanks of the E-3 orbits, U.S. Navy E-2C aircraft augmented the AWACS coverage, working principally with Navy aircraft, and a Saudi E-3 flew in a rear orbit over Central Saudi Arabia. Flying from Incirlik, Turkey, a contingent of three U.S. Air Force E-3 AWACS provided airborne control for the Proven Force missions into Iraq. NATO E-3 AWACS defended Turkey, but were not authorized to take part in offensive operations against Iraq. Both systems played their part: NATO for defensive purposes only and U.S. AWACS for controlling offensive strikes.¹⁵

AWACS aircraft organized the air battle, and airborne battlefield command and control center (ABCCC) aircraft, specially equipped Air Force EC-130s, took part in controlling air attacks against Iraqi ground forces. Several other systems acted with them. U.S. Air Force EC-135s served as radio relays for the ABCCC aircraft (antenna placement on the ABCCC aircraft hindered communications with aircraft at higher altitudes). Air Force OA-10s and Marine OV-10s and F/A-18Ds served as forward air controllers to direct strike aircraft on close air support missions. And the Joint Surveillance and Targeting Attack Radar System (JSTARS) aircraft, a late addition to the theater, detected moving Iraqi forces.¹⁶

The JSTARS aircraft was not designed to perform command and control, but it did, in part, serve in that role. JSTARS had advanced

¹⁵(S) Memo, Capt Guy Cafiero to GWAPS, Task Force 4, "E-3 Employment Desert Storm," AWACS File, GWAPS; (S) Intvw, CMSgt Jerome E. Schroeder with Maj Gen James L. Jamerson, Commander, JTF Proven Force, Ramstein AB, Germany, 27 Mar 1991, GWAPS, NA 124.

¹⁶Other aircraft, such as the U.S. Navy's S-3s and British Nimrods, also assisted with command and control connectivity—a particularly difficult task for the Coalition given the great distances to the target area and the broad dispersion of the strike aircraft.

radars to detect and track ground targets, but in 1990 it was still in development and had not undergone operational testing by the Air Force and Army. Nevertheless, two of these aircraft were pressed into use, and with civilian technicians to operate the equipment, arrived in the theater only days before the beginning of the air war. One of the two aircraft flew every night of the war, performing reconnaissance of Iraqi ground formations (and suspected Scud sites), passing targeting information to the ABCCC and AWACS aircraft, and even coordinating target information directly with the strike aircraft.¹⁷

Sixteen military and five commercial communications satellites made the command and control of Coalition forces possible. Fourteen U.S. military communications satellites were in orbit when the crisis began, and they were augmented by two others, one British (SKYNET) and one NATO spacecraft. Five leased commercial satellites and communications circuits were also added. Taken together, these systems provided a transmission rate of 200 million bits per second, or about 39,000 simultaneous telephone calls. Military systems provided approximately 75 percent of this total capacity.¹⁸ These space systems carried 90 percent of the intertheater communications and an undetermined, but substantial, portion of the intratheater.¹⁹

¹⁷(S) USCENTAF, "Joint Surveillance and Target Attack Radar System (JSTARS) Employment Concept," GWAPS, Microfilm Roll 10238. Target location and navigation by both aircraft and ground forces were tremendously assisted by a constellation of sixteen Global Positioning System satellites, intended for operational capability in 1991 but pressed into service ahead of schedule [US Space Command Assessment, pp 25-32; Andrew Wilson, ed, *Interavia Space Directory 1991-92* (Alexandria, VA: Jane's Information Group, 1991), pp 203-05].

¹⁸Joint Staff/J-6Z Brfg, "Use of Satellite Communications Desert Shield/Desert Storm," undated; Andrew Wilson, ed, *Interavia Space Directory 1991-92*; (S/NF) Rpt. Paul High, Jr, "Assessment of USCENTCOM Intelligence Communications Support (draft)," Apr 1992, S-127/IPSG-INCA, p 8884-28.

¹⁹The entire Desert Storm communications architecture was a collection of interconnected land-line, radio, and satellite systems. Since satellites were used for trunking of local distribution (indigenous systems could not handle the volume of Coalition communications traffic), phone conversations between units within a few miles of each other, sometimes even on the same base, could be connected via satellite.

Reconnaissance

Reconnaissance assets included an array of air and space systems. Spacecraft included a total of six meteorological satellites, three Defense Support Program satellites that scanned for and reported bright infrared "events"—the exhaust glow from Scud launches (the satellites were put in orbit originally to warn of a Soviet ballistic missile attack against the United States). Two civil satellites also provided imagery: the U.S. LANDSAT and the French SPOT.²⁰

A second category of U.S. reconnaissance assets were the strategic airborne reconnaissance platforms, a group of nine RC-135 Rivet Joint aircraft and nine U-2/TR-1 aircraft operated by Strategic Air Command.²¹ These aircraft had sophisticated sensors for collecting imagery and electronic intelligence, but they were vulnerable while flying in Iraqi airspace. Therefore, while the Coalition had a large array of strategic airborne and space systems, greater capability was needed for observing Iraqi forces and obtaining targeting data and bomb damage assessment, particularly during periods of cloud cover. For these tasks, the Coalition needed a third category of tactical reconnaissance—aircraft capable of flying under the clouds and penetrating Iraqi-defended airspace.

Tactical reconnaissance aircraft, this third category, proved deficient. The U.S. Air Force employed twenty-four RF-4Cs (six of them flying from Incirlik, Turkey), and even these were a late addition to the force. The six aircraft at Incirlik did not arrive until February 1991, and twelve of the other RF-4Cs did not arrive in the theater until just before the beginning of the air war; more were not sent, reportedly, because of a lack of ramp space.²² This "lack of ramp space" argument suggests that these assets were assigned an extremely low priority, resulting in a short-

²⁰(S/NF) Rpt, United States Space Command Operations Desert Shield and Desert Storm Assessment, Jan 1992, pp 10-24, 39-46; *Interavia Space Directory 1991-92*, pp 474-77, 467-69.

²¹The AWACS and JSTARS aircraft, mentioned in the first category of command and control, also had an immense reconnaissance capability, AWACS of airborne aircraft and JSTARS of ground traffic.

²²(S) U.S. Department of Defense, *Conduct of the Persian Gulf War*, Apr 1992, pp T-139-41.

age of tactical reconnaissance during the war. The Marine Corps had retired its own version of this aircraft, the RF-4B, only months prior to the war and before an operational replacement was available.²³

Other measures compensated for part of the shortfall in tactical reconnaissance. Six of the British Tornado aircraft (GR1As) and ten Saudi RF-5Cs flew reconnaissance missions throughout the war. A variety of fighter aircraft (F-16s, French and British Jaguars, F-14s, A-6s, and F/A-18s, the latter three mainly in maritime reconnaissance) flew reconnaissance missions in an attempt to overcome the shortage.²⁴ Finally, Pioneer unmanned aerial vehicles (UAVs), used by the U.S. Army, Navy, and Marine Corps, flew nearly 300 sorties during Desert Storm, mostly by the Marines. The UAVs had both infrared and television capability for day and night reconnaissance and were used for battleship gunfire support; identifying ships; finding missile sites, command bunkers, and Iraqi equipment; and assessing bomb damage.²⁵ But remotely piloted vehicles had neither the range nor the capabilities for large-scale reconnaissance. Inadequate numbers of aircraft that could penetrate enemy air space and take pictures of targets reflected a belief that national systems could take up the slack—a confidence that proved misplaced.

Electronic Warfare

Electronic warfare aircraft played a central role in the neutralization of the Iraqi air defense system, one of the most dramatic successes of the war that in turn made possible the type of air campaign that followed. Electronic warfare assets included airborne and space systems designed to collect electronic intelligence and aircraft devoted primarily to suppressing Iraqi electronic capabilities (communications, radars, and missile control centers). Given the importance of keeping Coalition aircraft attrition low, electronic warfare aircraft were of greater importance to overall air operations than ever before. Unavailability of electronic warfare aircraft, in fact, was a reason to abort an attack mission. Of the

²³Lt Gen Royal N. Moore, Jr., "Marine Air: There When Needed," *Proceedings*, Nov 1991, pp 63-70.

²⁴GWAPS Missions Database.

²⁵*Conduct of the Persian Gulf War*, pp 723-24.

one hundred mission packages flown from Incirlik during the war, only one was flown without such aircraft—the first night, before these aircraft had arrived at the base—and in that case, planners changed targets to a lower threat area than originally chosen.²⁶ Of the manned attack aircraft, only the F-117s did not require careful integration of electronic warfare aircraft support into mission planning. The United States dominated this mission area: of the nearly 3,000 electronic warfare sorties flown in Desert Storm, U.S. air forces conducted all but 80.²⁷

U.S. capabilities in electronic warfare included aircraft that destroyed Iraqi air defense radars. The sixty-one Air Force F-4Gs (almost the entire U.S. inventory, stationed in Bahrain and Incirlik) and twelve F-16s (specially configured versions of the F-16), flown from Incirlik, were dedicated to this mission. These aircraft attacked Iraqi surface-to-air-missile and warning radars, most often with AGM-88 high-speed anti-radiation missiles (HARMs) that sought out and destroyed air defense radar systems by homing in on their emissions. U.S. Navy and Marine Corps F/A-18s, EA-6Bs, and to a lesser extent A-7s carried HARMs (although none of these aircraft could equal the missile programming capability of the F-4G). The British had six Tornados capable of launching a similar type of missile.²⁸

Some aircraft could destroy radar systems, and many other aircraft had electronic jamming equipment to blind Iraqi radars and block radio communications. Often, this jamming equipment was in a pod attached to the aircraft, along with bombs and missiles, for self-protection of the aircraft. Such configurations were common, not just for U.S. aircraft but for other Coalition aircraft and Iraqi aircraft, as well. Decoy drones

²⁶(S) CMSgt Jerome E. Schroeder and SSgt Thomas L. Raab, History of Joint Task Force Proven Force, Office of History, Hq United States Air Forces in Europe, Dec 1991, p 59.

²⁷Those 80 sorties were by British Nimrod aircraft. GWAPS *Statistical Compendium*, Table 64.

²⁸(S) Robert W. Ward, et al. *Desert Storm Reconstruction Report*, Vol VIII: Space and Electronic Warfare (Alexandria, VA: Center for Naval Analyses, 1992), pp 3-30 to 3-35; "Despatch by Air Chief Marshal Sir Patrick Hine, RAF, Joint Commander of Operation Granby, Aug 1990-Apr 1991," second supplement to *The London Gazette*, Number 52589, 29 Jun 1991, p 40.

deceived Iraqi radars, diverting attention away from the Coalition aircraft and exciting the Iraqi radars—which then became HARM targets.²⁹

The most capable jamming equipment, however, was carried in aircraft dedicated to electronic jamming that masked the presence of the attack aircraft. The dedicated aircraft were the Air Force's twenty-four EF-111s and eight EC-130s and the Navy's twenty-seven and the Marine Corps' twelve EA-6Bs. For these types of aircraft, the Air Force component was a relatively small one. The numbers reflect the Navy and Marine Corps preference for relying more on dedicated electronic jamming aircraft than on attack aircraft carrying their own jamming pods. In this war, everyone sought the dedicated aircraft, and the EA-6Bs became the key non-U.S. Air Force resource that CENTAF employed to accompany Air Force attack aircraft.

Air-to-Air Combat Capability

The Coalition shared more widely the mission of controlling the air. The aircraft of six different countries took part in that mission, and of the air defense sorties during Desert Storm, the U.S. share was roughly 66 percent, rather than the 85 to 90 percent share of most other mission types. The Air Force F-15C and Navy F-14, approximately 100 of each, and 89 dual-role (air-to-air and air-to-ground) U.S. Navy F/A-18s served as the primary air-to-air fighters.³⁰ Saudi Arabia made the largest non-U.S. contribution, with 69 F-15Cs and another 24 Tornados (air defense variant), followed by Canada (18 CF-18s), Great Britain (18 Tornados), France (12 Mirage 2000s), and Bahrain (12 F-16s).³¹ More aircraft could have been available, since many of the air-to-ground aircraft were also capable of air-to-air missions (F-16s, for example), but the lack of incursions by Iraqi aircraft during the war made it unnecessary. On the contrary, some of the air defense fighters switched to dropping bombs during the war (the Saudi F-15s and Canadian CF-18s are two examples). The

²⁹*Conduct of the Persian Gulf War*, p 158.

³⁰The USAF F-16 is also a dual-role fighter, but it was not used in the air-to-air role during Desert Storm.

³¹This report does not address the ground components of air defense, such as Hawk and Patriot missiles and other ground and ship defense systems.

Kuwaiti F-1 squadron was an air-to-air unit, but because Iraq also flew F-1s (thus causing an aircraft identification problem), Kuwaiti F-1s were not allowed to fly air defense missions. They did, however, fly bombing missions, escorted by Kuwaiti A-4s so they could be readily identified.³²

The air defense mission and others such as reconnaissance, aerial refueling, and airlift began in earnest in August 1990, not January 1991. The number of combat air patrol missions during Desert Shield was similar to the defensive counterair missions of Desert Storm—13,887 and 13,075, respectively.³³ During Desert Shield, the U.S. portion of combat air patrol was similar to the portion flown in Desert Storm, approximately 67 percent, but the Service contributions were much different: the Marine Corps F/A-18s flew 4,461 combat air patrol sorties during Desert Shield, far out of proportion to the number of F/A-18s in the Corps, and more even such sorties than the Air Force (3,580). During this period, U.S. Navy carriers were not yet in the Gulf, and Marine aircraft in Bahrain were well placed to fly these sorties over the Gulf. The Marine Corps flew some escort missions during Desert Storm but no defensive counterair sorties, dedicating its effort instead to interdiction and close air support; the U.S. Navy essentially took over flying the defensive counterair sorties flown earlier by the Marines.³⁴

Attack

The largest air power mission in terms of numbers of sorties and of aircraft involved was surface target attack. The assets involved in this task included many types of aircraft and several very different weapons systems. Tables 6 and 7 give some idea of the variety of instruments used.³⁵

³²When the Kuwaiti F-1s flew, word was passed to the air defense network that F-1s in the company of the A-4s were not hostile. (Discussions, GWAPS personnel with Kuwaiti pilots, 15 Jul 1992, Kuwait City, Kuwait, GWAPS, NA 377.)

³³There were, in addition, another 14,000 air-to-air training missions during Desert Shield. GWAPS *Statistical Compendium*, Tables 47, 54, 58, and 64.

³⁴GWAPS *Statistical Compendium*, Tables 47, 68, and 69.

³⁵USAF F-4Gs and USN and USMC EA-6Bs, discussed under electronic warfare, could as well be included in this listing based on their HARM employment. (S) CENTAF Combat Plans Handout, "Desert Shield Beddown/Sortie Rates," as of 15 Jan

Table 6
Desert Storm Attack Aircraft

Organization	Type*	Number
U.S. Air Force	A-10	132
	B-52	66
	F-15E	48
	F-16	244
	F-111E	18
	F-111F	64
	F-117	42
U.S. Navy	A-6	95
	A-7	24
	F/A-18	89
U.S. Marine Corps	A-6	20
	AV-8B	86
	F/A-18A/C/D	84
	AH-1W	50
U.S. Army	AH-64	274
U.S. Special Operations Command	AC-130	4
Saudi Arabia	Tornado	24
	F-5	87
Great Britain	Tornado	39
	Jaguar	12
	Buccaneer	12
Kuwait	A-4	20
	F-1	15
France	Jaguar	24
Bahrain	F-5	12
Italy	Tornado	10

* Numbers are approximate, and only those aircraft flying at least one-hundred sorties are included. Numbers of aircraft varied somewhat during the war because of attrition, replacement, and routine movements and include attack aircraft based out of the theater at Incirlik, Moron, Fairford, and Diego Garcia.

1991, GWAPS Microfilm Roll 10264, AFHRA 00269612; *Conduct of the Persian Gulf War*, pp 666-70, 787.

Table 7
Missiles Employed in Desert Storm Strikes

Organization	Type	Number launched
U.S. Navy	Tactical Land Attack Missile (TLAM)	282 (last one launched on 1 Feb)
U.S. Army	Army Tactical Missile System (ATACMS)*	21 missions (some missions had two missiles employed)
U.S. Air Force	Conventional air-launched cruise missile (CALCM)	35 (all launched the first day of the air war)

* The ATACMS is included in this section on air strikes simply because its range—over 50 miles—sets it apart from other rocket systems and naval gunfire.

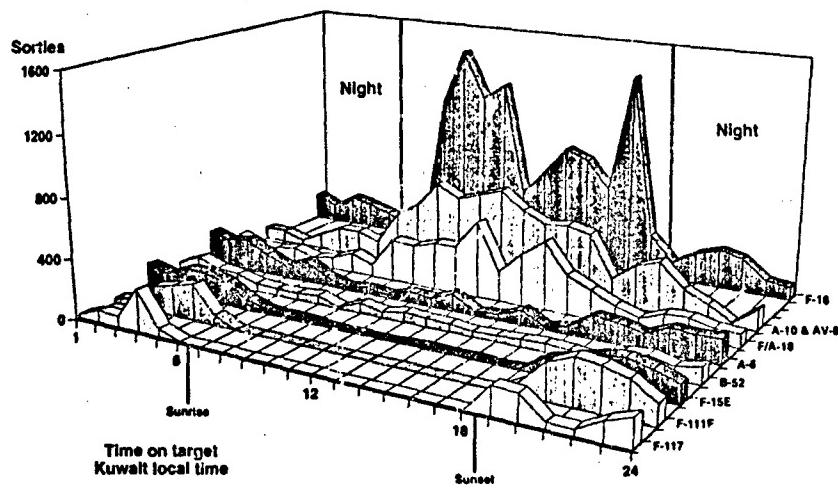
U.S. aircraft flew some 88 percent of the over 46,000 attack sorties conducted during Desert Storm (counting fixed-wing aircraft only); the Air Force alone flew 60 percent.³⁶ Nearly all attack helicopter missions were by U.S. forces. Numbers of sorties alone do not give the dimensions of the contributions of each type of aircraft, however; for that one has to look more closely.

Though air attacks took place around the clock, few units flew on twenty-four-hour-a-day operations: the F-117s, F-111(E and F)s, A-6s, and F-15Es flew almost entirely at night; TLAM attacks on Baghdad, after the first night, took place mostly during the day in order to keep the pressure on day and night (the only other strikes on downtown Baghdad were by the night-flying F-117s); some aircraft flew almost entirely day missions because of limited night capability—AV-8Bs, Jaguars, A-4s; and the A-10s, F-16s, and F/A-18s flew mostly during the day but had some aircraft or crews dedicated to night flying; B-52s attacked both day and

³⁶Attack sorties counted are those of interdiction, close air support, and airfield attack (under the offensive counterair category). GWAPS Composite Sorties Database; Lt Col Steven L. Head, "Briefing on the Conduct and Performance of the Air Campaign in Operation Desert Storm," 21 Mar 1991, GWAPS, CHO 1-2.

night in order to create the impression of continuous bombing, to maximize the psychological aspects of those attacks (See Figure 33).

Figure 33
Coalition Attack Aircraft Sorties by Time on Target
17 January - 28 February 1991



The Coalition placed a premium on aircraft with the self-contained capability to laser-designate targets for laser-guided bombs, and those aircraft were more valuable than sortie count alone would indicate. They were the F-117s, F-111Fs (but not the F-111Es), F-15Es, A-6s, French Jaguars, Saudi F-5s, British Buccaneers, and some British Tornados.³⁷ While not a particularly new capability (laser designation appeared late in the Vietnam War), many of the newest aircraft, F-16s and F/A-18s, for instance, lacked it; the F-15Es only received laser-targeting capability after the aircraft had deployed to the theater. While the Air Force had a surplus of capabilities in some areas, nearly every aircraft capable of laser designation went to the theater, and more were needed. The Proven Force wing at Incirlik attempted to secure at least some capability by bringing in F-4E aircraft from Clark Air Base in the Philippines, but those aircraft arrived just before the war

³⁷The Buccaneers, F-5s, and Jaguars had this capability during daylight only.

ended. The Buccaneers were another late addition to the war, brought in by the British when the laser-designating capability was deemed particularly valuable. The Buccaneers laser-designated their targets during daytime while flying with the bomb-carrying British Tornados. Later in the war, the British expedited to the theater a day and night laser-designating capability, then still under development, for use on some of the British Tornados.³⁸

During the war, the U.S. Air Force made the greatest use of precision munitions, both missiles and laser-guided bombs, on attack aircraft. Table 8 compares Air Force, Navy, and Marine Corps use of the three types of precision weapons expended and presents additional information on British and French capabilities:³⁹

The Air Force, in flying 60 percent of the attack missions, expended far higher percentages of guided bombs and air-to-surface missiles than the Navy or Marine Corps. The expenditure of guided bombs reflected the Air Force's heavy bombardment of Iraqi aircraft shelters and employment of F-111Fs and F-15Es in attacking Iraqi armor in the Kuwait theater.⁴⁰ The employment of Maverick missiles, almost entirely by A-10s, showed the dedication of those aircraft to Iraqi equipment attrition in the Kuwait theater. The use of the Maverick by A-10s stands in stark contrast to the slight use of the same by other aircraft, most notably the F-16s, which used only 116—far fewer than the planners had anticipated.

The Navy and Marine Corps used relatively few guided bombs and air-to-surface missiles. A shortage of these weapons in the stocks available to the Navy and Marine Corps provides the best explanation for the lack of employment. In addition, the supply of precision munitions was being husbanded for possible use during the ground offensive. As it turned out, the rate of employment of precision munitions during the ground war by all

³⁸"Despatch by Air Chief Marshal Sir Patrick Hine," p 42.

³⁹The Directorate of Supply, Hq. USAF/LGS, Combat Support Division (LGSP), also contained in GWAPS *Statistical Compendium*, Tables 188, 189, and 190; (S) G. J. Onslow, Operational Research Branch Note for the Record 01/91: Analysis of Attack and Reconnaissance Operations During Operation Granby (Hq Strike Command, Royal Air Force, ORB NFR 1/91, Jul 1991), pp A-2, C-2, GWAPS, NA 515.

⁴⁰GWAPS Missions Database, as displayed in GWAPS *Statistical Compendium*, Tables 183 and 184.

fixed-wing aircraft was far less than expected, a result of both the weather and the tactical conditions at the time.⁴¹

Table 8
Desert Shield/Desert Storm U.S. Weapons Expenditures
(and Percent of Total U.S. Expenditure)

Munition types:	Guided bombs, all types	Anti-radiation missiles (princi- pally HARMs)	Air-to-surface missiles (Maverick for AF; principally Walleye for N and MC)
Air Force	8,456 (90%)	1,120 (55%)	5,255 (96%)
Navy	623 (7%)	679 (33%)	147 (3%)
Marine Corps	263 (3%)	240 (12%)	46 (1%)
Totals	9,342	2,039	5,448
Royal Air Force (UK)	1,126	112 Air- Launched Anti- radiation Missiles (ALARMs)	N/A
French Air Force	N/A	N/A	approx 60 AS-30s (laser-guided mis- siles)
Grand Totals	10,468 (U.S. 89%)	2,151 (U.S. 95%)	5,508 (U.S. 99%)

⁴¹(S) Frank Schwamb, et al, *Desert Storm Reconstruction Report, Vol II: Strike Warfare* (Alexandria, VA: Center for Naval Analyses, 1991), pp 6-1 through 6-11;
(S) John D. Parsons, Benjamin T. Regala, and Orman H. Paananen, *Marine Corps Desert Storm Reconstruction Report, Vol IV: Third Marine Aircraft Wing Operations* (Alexandria, VA: Center for Naval Analyses, 1992), pp 27, 79.

The attack helicopters of the U.S. Army and Marine Corps belong in any description of air power employed in the Gulf War. The numbers shown in Table 7 account for only the most capable of the attack helicopters, the ones primarily used to attack Iraqi armor.⁴² The commitment of attack helicopters in this war was a particularly heavy one: the number of AH-64 Apaches represented nearly half of the Army's fleet of that aircraft, and four of the six Marine AH-1W squadrons were in the theater.⁴³ Most strikes by these attack helicopters took place during the ground war, as they advanced with, and sometimes ahead of, the ground forces. Marine Corps and Army VII Corps attack helicopters operated close to the front lines, but in the areas of the XVIII Airborne Corps, the AH-64s engaged in several independent deep operations, apart from the ground elements, against withdrawing Iraqi troops. The main weapon of these aircraft for antiarmor operations was the Hellfire missile. During the war, the U.S. Army expended 2,876 Hellfire missiles and the Marine Corps expended 159.⁴⁴

Summary

Coalition air power was overwhelming in both numbers and in quality. That predominance applied to the more typical elements of air power: air-to-air fighters, air-to-ground attack aircraft, and airlift aircraft. It applied even more to the Coalition's special capabilities in air power: aerial refueling, airborne and satellite reconnaissance, electronic warfare, airborne command and control, stealth, and precision munitions. These special capabilities, ones that Iraq could not even begin to cope with, were the province of U.S. forces; while other Coalition air forces pos-

⁴²In addition to the Army AH-64 and Marine Corps AH-1W, the French Army Gazelle and the British Lynx helicopters were employed in attack roles. The Royal Navy Lynx helicopters firing Sea Skua air-to-surface missiles, for instance, was one of the most effective weapons systems against Iraqi ships [(S) Jeffrey Lutz, et al, *Desert Storm Reconstruction Report, Vol VI: Antisurface Warfare* (Alexandria, VA: Center for Naval Analyses, 1991), pp 3-14 through 3-17]. There were several hundred other helicopters that performed missions of armed reconnaissance, escort, and maritime surveillance [AH-1J/F/T, OH-58D, and MH-53E Light Airborne Multipurpose system (LAMPS) helicopter].

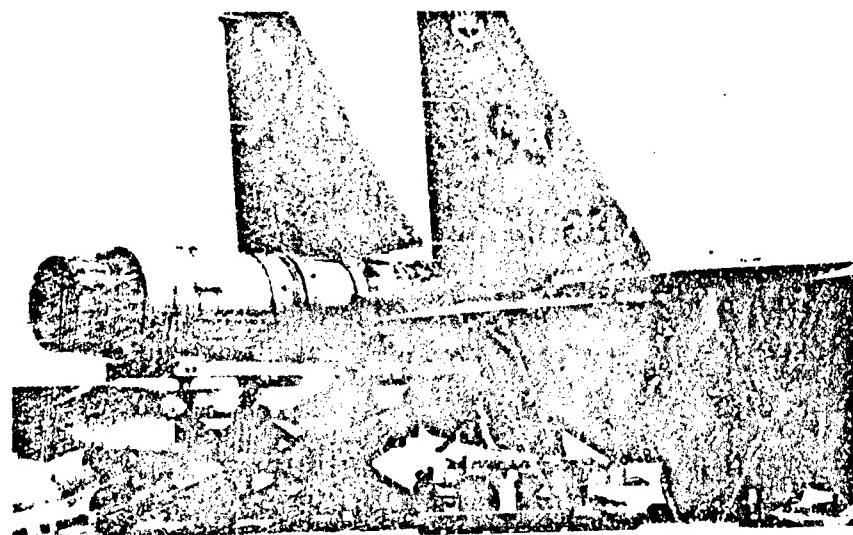
⁴³*Conduct of the Persian Gulf War*, pp 666, 669.

⁴⁴See Chapter 3, Table 3.

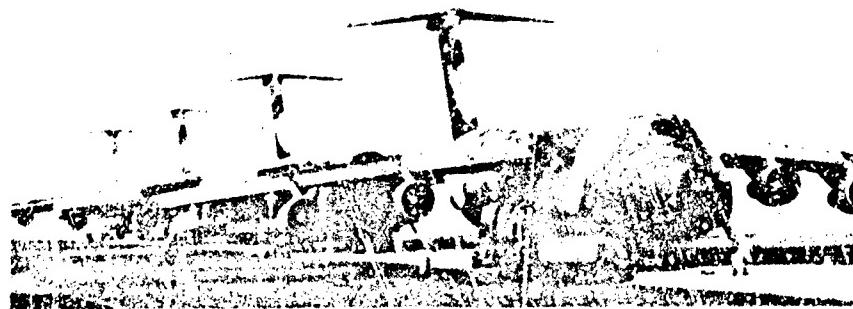
sessed some of these capabilities (except for stealth), their contribution was nowhere near that of the United States.

How much of its total air power capability did the United States employ? The answers vary, but in the special capabilities mentioned above, the United States was close to fully committed: effectively all of the stealth capability and airborne designators for laser-guided bombs; the predominant amount of reconnaissance and electronic warfare aircraft; and over half of aerial refueling and command and control assets. Furthermore, over half of the U.S. Air Force aircraft normally stationed in Europe participated in the Gulf War.

The high percentages of U.S. air power devoted to the Gulf War does not necessarily mean that the United States would have been unable to apply air power in another contingency elsewhere at the same time. The emergence of a second contingency would have called for a reappraisal of the air power needed for the Gulf War and of the options for air employment. Clearly, some flexibility was possible. That flexibility would have entailed adjustments of aircraft sortie rates, target or mission priorities, and the tempo of the air campaign. In addition, while the Air Force, Navy, and Marine Corps used a large part of their Reserve components in airlift and aerial refueling, only three tactical fighter squadrons (two F-16 and one A-10) from the Reserves took part. The flexibility, however, lay at the lower technology end of the available air power, not in the higher technology, special capabilities. All that can be reasonably said is that facing multiple contingencies the United States would have fought a very different war with air power in the Gulf.



(Above) F-15E
engine change
at Al Kharj, SA.
(Right) Weapons
loading, F-16s at
Al Minhad, UAE.



C-5s on the flightline at Rhein Main AB, Germany, enroute to Saudi Arabia.

What Supported the Air Power?

The air power described in the previous chapter was the combat potential or operational instruments of air power, and as such represented only the end product of the organizations, doctrine, training, supplies and support structure required to make aircraft or satellites militarily significant. This chapter focuses on other elements necessary for employing air power, dividing them into two categories: the tangible and the intangible. The intangibles include aspects of doctrine, predispositions to the use of air power, and the role of air power in military operations (some would say mindset) that affected air planning and operations. They also include the expectations of the different Services concerning the integration of air power in land or sea operations, the effect of the orientation by Great Britain and the United States to NATO employment; concepts for using air power, and the effects of the Vietnam experience on senior American leadership. The tangibles are the vast support structure of supply, maintenance, communications, and people to which all aircraft and other operational systems are tethered. First, the tangibles.

On the eve of the Gulf conflict the, United States had an extensive system of bases and lines of communications for projecting and sustaining air power, but that support structure, a product of the Cold War, was centered in the United States and Europe and required further extension to support a Southwest Asian conflict. Materiel prepositioned in the theater and the number of bases available in the Gulf states provided a great advantage for U.S. military planners, as did the amount of preparation time between the August invasion and the start of Desert Storm in January 1991. The key to success, however, was a willingness to innovate and adapt when plans changed and automated systems failed. Despite some early chaos and a continuing lack of precise accountability for much of the equipment and supplies that flooded into the theater, the air campaign was never constrained by a lack of fuel, parts, or maintenance capability, truly a remarkable accomplishment. Airlift forces proved vital to the success of this support and, by enabling other U.S. forces, to the entire Coalition effort. By war's end, strategic airlift had moved more than 500,000 people and 540,000 tons of cargo, an unprecedented

amount, to the theater. Once in the region, tactical airlift moved over half that amount again within the theater.¹

Moving units and supplies to the Persian Gulf involved not only spanning great distances but also adapting to an unusual deployment concept. For most logistics planning, the Air Force aircraft squadron had been the basic combat unit that would deploy from operational bases in the United States to operational bases overseas. Such a concept did not fit the situation in the Southwest Asian theater, where the entire operational base itself had to be deployed. Saudi Arabia was by no means lacking in operational bases for its own use, but neither it nor the other Gulf states had ever experienced a deployment the size and speed of Desert Shield. Many units deployed to newly built, bare bases with no available support structure and about which little was known. Most of the early deploying units did not even know where they were being sent until just before or, in some cases, during the deployment itself.²

Since no approved time-phased deployment schedule existed for Desert Shield, units quickly had to estimate equipment tonnage, passengers, cargo size, and destinations. The resulting errors made projecting airlift requirements highly problematic. For example, estimated lift requirements for the first seven deploying units increased 60 percent between 11 and 13 August and forced the Military Airlift Command to schedule additional, unforeseen sorties and to delay airlift for follow-on support units.³ It was not until 14 August that Central Command published the first complete deployment schedule, only to learn that it exceeded Military Airlift Command's capability by 200-300 percent. As a result, deploying fighter squadrons did not receive necessary airlift support, and from there the problems cascaded. The Joint Operation Planning and Execution System (JOPES) automated deployment system was incapable of tracking partial shipments of equipment and, as a result, quickly lost accountability of more than half of all the shipments rushed to the Gulf. Moreover, since destinations and associated units were

¹GWAPS *Statistical Compendium*, Table 23.

²On 9 and 10 August 1990, squadrons of F-15Es and F-16s had their destinations changed while they were in mid-flight. [William T. Y'Blood, *The Eagle and the Scorpion: The USAF and the Desert Shield First-Phase Deployment, 7 August - 8 November 1990* (Washington, DC: Center for Air Force History, 1992), pp 51-52; "4th Tactical Fighter Wing in Southwest Asia," p 18.]

³(S) RAND, *Assessment of Desert Shield Deployment*, 10 Oct 1991, pp 57-58.

classified, cargo was often shipped to "Desert Shield" and invariably ended up at Dhahran, unmarked as to final destination or priority.⁴

When Central Command assigned priority to move combat power to the theater, sustaining supplies became backlogged awaiting shipment along with partial sets of unit equipment. A second difficulty arose at this juncture because the separate supply and transportation systems, while having independent tracking mechanisms, had poor connectivity. Therefore, supply items became "invisible" during shipping and could not be tracked down, much less expedited. Invariably, an item delayed meant an item reordered, further clogging the system. Furthermore, the backlogs of equipment and supplies in the United States awaiting shipment were insignificant when compared to the situation at Dhahran where the backlog of arriving supplies awaiting further sorting and distribution soon reached crisis proportions.

With such an unpromising start, it was all the more remarkable that supplies flowed as well as they did and that the Air Force could later claim that no Desert Storm sortie was lost because of unavailability of repair parts. Those results came from new procedures instituted on the fly. First, the Air Force supply system envisioned for the theater had to be completely abandoned—its computer system was inadequate, and the designed telecommunications capability never worked properly. As a result, at the end of August 1990, all Air Force Desert Shield supply accounting was transferred to a mainframe system at Langley Air Force Base, Virginia. This system included almost all aircraft supplies but only 50 to 60 percent of all other supplies. Still, with over 288,000 item records, it was the largest Air Force retail supply account ever assembled.⁵

When the supply system began to resemble a water pipe crimped at both ends, the transportation system went to work eliminating the backlogs. Military Airlift Command personnel reviewed cargo at the aerial ports in the United States and found that over half of it was coded as top priority, but much of it did not need to go by air at all; teams periodically went through

⁴*Ibid.*, p 10.

⁵CENTAF Supply Support Activity briefing viewgraphs, undated, provided to GWAPS during 4-5 Aug 1992 intvw, GWAPS. NA 584.

the cargo and redesignated some for sea transport.⁶ At the other end of the pipeline, units did the best they could to get the material out of Dhahran:

Deployed tactical airlift units would fly the first sortie of the day to Dhahran and leave several people (from units deployed to the various operating locations) there to roam about the yard looking for their shipments and return on the last sortie of the day with whatever they had found.⁷

Military Airlift Command addressed weaknesses in the priority system by setting up a special airlift route, Desert Express, to move critical parts to the Gulf quickly. By the end of October 1990, a MAC cargo aircraft flew daily to the theater from Charleston Air Force Base, South Carolina, with the most critical parts needed for wartime readiness. Commercial air express services brought critical supplies to Charleston, where they were transloaded to Desert Express and delivered to the theater usually within 72 hours of requisition (previously, it took as long as two weeks). A similar system, European Express, brought parts to the Gulf from Europe. Results were dramatic: grounding actions for Air Force aircraft decreased from 500 (for the 750 aircraft being maintained) on 1 October 1990 to 219 (for 1,229 aircraft) on 17 January 1991. No comparative data are available for the other Services, but they received similar service—half of the shipments, in fact, were destined for Army units. During Desert Storm, the overall rate for Air Force aircraft being unready to fly because of supply shortages was less than 4 percent, better even than the standard for peacetime, and far less than the projected war standard of up to 25 percent after 30 days of combat.⁸

Supplying jet fuel for Coalition aircraft could have been an even greater problem than spare parts, had it not been for fuels support by the host nations and requisitioning refueling equipment from Air Force units around the world. The amounts needed were staggering; the Air Force alone used fifteen million gallons of jet fuel *a day* at the height of the war. Except for some specialized jet fuels, Saudi Arabia, Oman, and the United Arab Emirates contributed all fuel for land, sea, and air operations—approximately \$2 billion dollars worth—and negated the need for a substantial sealift effort by an inadequate U.S. sealift tanker fleet. Storing, transporting, and issuing

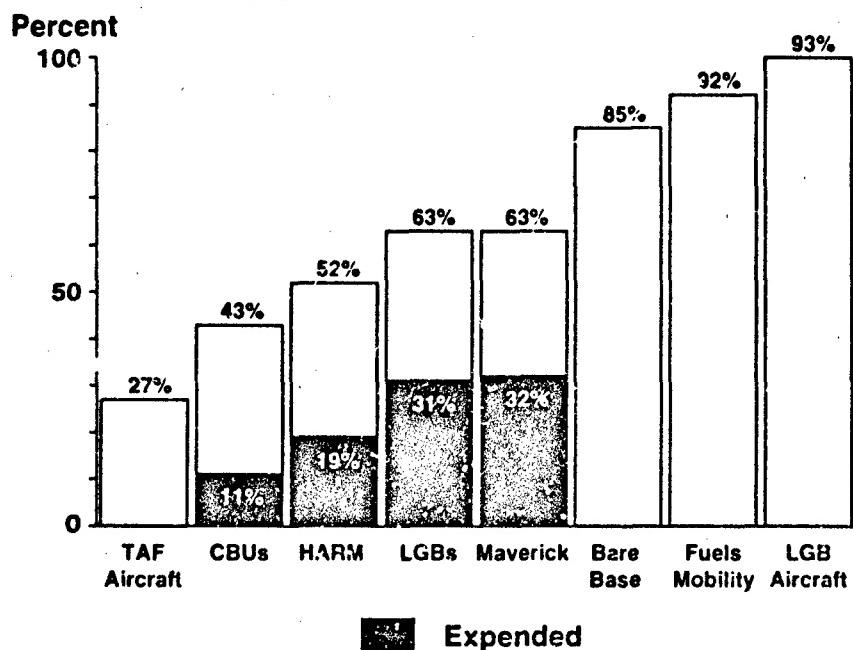
⁶ JWL 13 Number 31952-58451 (00218), submitted by Jerry Rife; RAND, *Assessment of Desert Shield Deployment*, p 68; Lt Gen Vernon J. Kondra, *Operation Desert Shield - Desert Storm: The Vernon J. Kondra Notes*, 24 August 1990 - 31 May 1992, transcribed by Clayton Sneedeker, 21st AF Historian (McGuire AFB, NJ: 21st AF, 1992), pp 16-17.

⁷ MAC/LERX staff paper, undated, provided during an interview with Mr. Orson Glover, HQ MAC/LGSW, 11-12 Aug 1992.

⁸ Background Paper, "CENTAF Logistics Story," CENTAF/LG, Apr 1991.

this fuel remained as a significant obstacle that was surmounted by a combination of new pipelines and the Air Force's supply of fuel bladders, hydrant systems, refueling vehicles, and trained personnel gathered from all over the United States, Europe, and the Pacific. However, to meet this requirement, the Air Force deployed ninety-two percent of its entire refueling assets to the theater, leaving other combatant commands with limited ability to establish any kind of bare-base aircraft refueling capability had that been necessary. This would not have been the only shortfall, since the Air Force had also deployed eighty-five percent of all its equipment for operating from bare bases—tents, dining facilities, and so forth—to the Gulf (See Figure 34).

Figure 34
Deployment of Selected USAF Assets



Problems with supplying aircraft munitions were similar to those for sustainment supplies—and might have brought significant degradations to air operations in August or September of 1990—but were overcome by the start of the air campaign. Here, accurate accounting of munitions was necessary because the Air Force employed more than thirty kinds, the Navy nine varieties, and Army aviation thirteen. The other Coalition air forces added some twenty-six unique types of their own munitions. Furthermore, Central Command Air Forces (CENTAF) had anticipated a forty-five day transit time for munitions from the United States, but the actual time was fifty-five

to seventy-two days, and in many cases, that transit time was to the Gulf port, not to the intended destination.⁹

Munitions shipments also faced other complications. Specific transportation restrictions limited the number of roads, railroads, and ports (only two in the United States) that could be used. In addition, shortages of qualified drivers and explosives handlers exacerbated accounting problems for inventories of munitions components. Despite the nearly \$100 million spent on the Air Force's Combat Ammunition System since its inception in 1982, it was not prepared to handle the task. Specific munitions in the transportation system could not be tracked, leaving logisticians the unenviable task of determining what exactly had arrived on ammunition ships as they were unloaded.¹⁰ Inventories had to be created and maintained manually, a process that continued throughout Desert Shield and Desert Storm and resulted in significant inaccuracies in reported inventories. Senior Air Force planners never could be confident of what munitions were actually available. One saving grace came from the Air Force Combat Ammunition Center located at Sierra Army Depot, California. Established in 1985, the Center sought to develop a cadre of trained personnel skilled in managing munitions production. Graduates of this training constituted the backbone of the production teams in the theater.

While inventory accounting problems had the potential to create munitions shortages, those uncertainties were offset by the large quantities of munitions shipped. By the cease-fire, nearly 350,000 tons of munitions had been shipped by air and sea for use by Air Force units (including 48 ships en route); of this amount, 69,000 tons were actually expended. The percentages listed in Figure 34 depict the major munitions employed in the war. As the figure indicates, stocks of all munitions remained at the end of the war, but some rationing took place in special munitions, such as the CBU-87 and laser-guided bombs, particularly by the Navy and Marine Corps, in anticipation of a longer ground war or higher expenditures of these munitions.¹¹

⁹Rpt. USAF/ACP to General Accounting Office, "Munitions Activity in SWA," Jan 1992.

¹⁰(S) Intvw, Lt Col William Swezey, ASD/ALZ, 15 Apr 1992 (Lt Col Swezey was the senior munitions manager in CENTAF during Operations Desert Shield and Desert Storm).

¹¹(S) David L. Dittmer, *U.S. Marine Corps Operations in Desert Shield/Desert Storm, Volume I: Overview and Summary* (Alexandria, VA: Center for Naval Analyses, 1992), p 36; (S) Ronald Nickel, et al, *Desert Storm Reconstruction Report, Volume IX: Logistics* (Alexandria, VA: Center for Naval Analyses, 1991), p 3-11.

Prepositioned stocks of munitions and equipment in the theater helped enormously. The Air Force had stocked approximately \$1 billion worth of fuel, munitions, and equipment in the Gulf states and aboard 3 maritime prepositioned ships. These stocks represented approximately 3,500 airlift cargo missions for Air Force stocks alone and a total of over 10,000 sorties for all Services. The importance of this prepositioning can be grasped by noting that the total of all intertheater airlift sorties during the first phase of the deployment (August to November, 1990) amounted to just over 6,000 sorties.¹²

Prepositioned munitions accounted for about half of the tonnage eventually dropped in the war, but the proportions of specific munitions varied. The prepositioned stocks represented a mix of conventional ordnance—Mk-80 series general-purpose bombs, Vietnam-vintage cluster bombs, and some laser-guided bomb components. However, the munitions ashore did not contain the latest technology weapons for security and safety reasons.¹³ As a result, many more precision munitions were brought to the theater than were included in the prepositioned stocks.

Early in the deployment, CENTAF had to rely on whatever munitions were available in the prepositioned stocks, but matching those munitions with aircraft was a difficult and time-consuming problem, with some units having access only to the munitions with which they deployed. CENTAF established a priority of critical munitions—primarily items for the conduct of defensive operations—but these priority munitions did not arrive in the theater for up to six weeks.

On a more positive note, aircraft maintenance achieved excellent results. One factor leading to this success was the attention given to securing needed supplies and spare parts described earlier. A second major factor was the Air Force's innovative concept for establishing centralized maintenance support centers. Engines, for example, were serviced in Europe and on Guam rather than at the individual bases in the theater, giving better efficiency to the entire process. Establishing such centers on the theater's bare bases would have overstrained the base support structure. Even so, theater maintenance was a major effort, and one measure of that effort was that approximately 38 percent (17,000) of all Air Force personnel deployed in the theater were maintenance person-

¹²For much of this material, airlift would have been inefficient use of the aircraft, but the material could not have been available as soon in any other way.

¹³(S) Intvw, AF/LGSP personnel, 2 Apr 1992.

nel.¹⁴ All indications were, moreover, that there were not too many maintenance personnel in the theater; in fact, there were one-third fewer than Air Force planners had anticipated would be needed to support the number of aircraft deployed and provide the kinds of maintenance required under combat conditions.¹⁵

Maintenance in-commission rates for Air Force aircraft also were excellent, but whether they were better than in peacetime, as sometimes claimed, is open to question. Differences between the peacetime and (the largely ad hoc) Desert Shield-Desert Storm reporting systems make comparisons inexact. Whatever the comparison, the rates achieved were superb, considering repairs to battle-damaged aircraft and the harsh desert environment. Other Services achieved similar in-commission rates with their flying units, except for isolated problems. The desert environment appears to have had little persistent effect on reliability, except for the T-64 and T-700 helicopter engines (used on the CH/MH-53 and MH/S-60 helicopters, respectively), which experienced sand erosion problems that brought reliability to only one-tenth of rates anticipated.

Another tangible element of support was communications. Providing ground and air communications and control throughout the theater of operations forced Central Command to deploy entire systems. Central Command immediately deployed satellite communication terminals and eventually employed over 7,200 terminals and pieces of equipment that were linked electronically to more than 63 communications, intelligence, navigation, and weather monitoring satellites.¹⁶ In comparison, only 3 terminals existed on land in the theater before 2 August 1990. This communications explosion typified the increases taking place in several

¹⁴(S) Briefing, AFMEA/MEMS, "Desert Shield vs Europe Force Projection/Support," Jan 1991; USAF Wartime Manpower and Personnel Readiness Team Desert Shield/Desert Storm Electronic Database; USAF Statistical Digest: Fiscal Year 1991 Estimate, pp D-38 and D-48.

¹⁵No judgements are implied about the "correct" tooth-to-tail ratio. The ratios of specialties of Air Force personnel would vary considerably depending on numbers of engineering, security, or other personnel, based on the operating environment, host nation support, and so forth.

¹⁶(S/NF) Rpt, United States Space Command Operations Desert Shield and Desert Storm Assessment, Jan 1992, pp 6, 16, 27, 34; Joint Staff/J6Z Briefing, "Use of Satellite Communications Desert Shield/Desert Storm," undated; Col Alan D. Campen, USAF (Ret), Gulf War's Silent Warriors Bind U.S. Units Via Space," *Signal*, Aug 1991, p 83. The above sources put the number of communications terminals at between 1,200 and 2,000.

areas. The use of the secure telephone, the STU-III, became a vital link in every operational element. The Saudis, into whose telephone system these instruments were linked, asked for access to the secure system. Since the STU-III's were based on sensitive technology, the National Security Agency modified a commercial version of the STU-III and distributed sets to the Arab forces. These modified sets could communicate only with others of their type, could not link with a STU-III, and could not link with the STU-II's used by NATO forces. As a result, U.S. commanders had to use multiple phone lines to talk to all the members of the Coalition.¹⁷ Even with these shortcomings, Central Command established more communications links in the first 90 days of Desert Shield than U.S. forces had assembled in Europe in the past 40 years. Forty Automatic Voice Network trunks were in Europe; 265 were functioning in Saudi Arabia by March 1991.¹⁸

As with land communications, the number of aircraft arriving in the theater quickly overwhelmed the capabilities of the air traffic control system. Large gaps in radar and radio coverage created flight safety problems and magnified the difficulty of providing adequate air defense. The complex airspace structure created to handle the 3,000 sorties a day during Desert Storm grew to 122 airborne refueling orbits, 195 Army aviation flight routes, 76 strike routes, 36 training areas, 60 Patriot engagement zones, and a host of other areas, routes, and orbits. CENTAF deployed approximately 320 controllers to handle the U.S. facilities and augment host nation air controllers. The Army, Navy, and Marines also deployed organic air control equipment and controllers to support their operations.¹⁹

Handling the volume of aircraft airborne at any one time required an extensive network even in peacetime; adding communications and control procedures in a wartime environment compounded problems in all systems and networks. With more than 900 frequencies in the daily air tasking order by January, virtually saturating the frequency spectrum, the CENTAF staff formed a planning group to manage radio frequency allocation. The group

¹⁷Coi Randy Witt, "Air Force Tactical Communications in War, the Desert Shield/Desert Storm Comm Story," Hq. USCENTAF, Riyadh, Mar 1991, p 2-38, GWAPS, NA 49.

¹⁸(S) Defense Science Board, *Lessons Learned During Operation Desert Shield & Desert Storm*, "for comment" draft (Washington, DC, 1992), p 5; "Lessons From The First Space War," *Interavia Space Markets*, Apr 1991, p 10.

¹⁹Memo, Maj Howdesheli, AFCC, Air Traffic Service, to Maj Leary, GWAPS, subj: Air Traffic Support of Desert Storm, 27 May 1992; (S) Defense Science Board, *Lessons Learned During Operations Desert Shield & Desert Storm*, pp 20-21.

had to take note of the frequencies used by the Saudis, who did not have an assignment policy, and those of Army units on the ground; in such an environment, the chances for communications interruptions and radio interference were enormous. For security purposes, the frequencies during wartime were usually changed daily, but CENTAF had to abandon this practice.²⁰ In short, creating and staffing this control system was a tremendous effort and could only be done in steps. Although the system was put together piecemeal beginning in August 1990, it was operating as an entire system in a month and was multinational by the end of December. To do this, however, the Air Force depleted command and control units in the U.S. and Europe to the point where it exhausted effective tactical air command and control reserves.

One of the most misleading but accurate statistics was that less than ten percent of active duty Air Force personnel deployed to the Gulf.²¹ It is misleading because so much more of the Air Force's total capability was dedicated to that theater. In addition, without considering the deployed units themselves, the numbers give no indication of the total number of Air Force units affected. A review of the identities of the Air Force wings and air divisions in the theater would reveal a "(P)" following their designations, meaning "provisional." That is, the unit combined personnel and squadrons from more than one existing unit. Thus, no Air Force wing deployed in total to the Gulf but dispatched flying squadrons that would join other squadrons in the Gulf to form new, provisional wings.

The composition of wings took on many variations for Desert Shield and Desert Storm. One pattern was to deploy two of a wing's three flying squadrons, usually sending with them the most experienced crews, best aircraft, and an augmented crew force and support staff. What remained on the home station was something less than one-third of a wing. The two squadrons joined in the theater at some later date (during the second phase of the deployments) with one or more squadrons from other wing(s) (from Europe, for instance) and formed a provisional wing. As an example, the 4th Tactical Fighter Wing (TFW) at Al Kharj consisted of the two squadrons it deployed, the 335th and 336d Tactical Fighter Squadrons (TFS) flying F-15Es, plus the 53d TFS (of the 36th TFW, Bitburg Air Base, Germany) flying F-15Cs, and the 157th TFS and 138th TFS (from the Reserves) flying F-16s. There were exceptions, such as when all of a wing's squadrons deployed to the same provisional wing, but even then that

²⁰"Air Force Tactical Communications in War," p 2-16.

²¹Approximately five percent of the Air Force Reserve and four percent of the Air National Guard were deployed. GWAPS *Statistical Compendium*, Table 40.

wing contained elements of several other flying units. The B-52s were even more fragmented, deploying in only partial squadrons because the squadrons also maintained a nuclear alert commitment in the United States.

Nonflying Air Force personnel deployed in far more fragmented units than did flying personnel. These personnel, both active and reserve, were selected to deploy by *functional*, not *organizational*, designation. A maintenance squadron in the United States or Europe, for example, would be ordered to deploy six jet engine mechanics; this group could then be further split and deployed to different provisional units in the Gulf. While a provisional wing was composed of two, three, or even four flying units, the balance of the wing could come from an array of units. This practice was criticized widely in at least two respects. First was unit cohesion. Support organizations created in the theater were composed of officers and enlisted personnel who did not know and had not worked with one another. This situation became even more difficult, since individuals were assigned temporarily to provisional units, so their administrative control (for pay, accountability, promotions, and the like) remained with their original units. The difficulties for Reservists in this situation were even greater, since they often fell under different accounting rules.²² Another problem involved the depletion of resources from the parent units, making them less able to respond to a crisis or further deployment. Here too, the Reserves were most affected because they first lost personnel who volunteered and later, personnel called up to fill other requirements. Their absence could have affected the unit's readiness and ability to meet unit requirements.²³

Air Reserve Components (Air Force Reserve and Air National Guard) made up roughly 20 percent of total Air Force personnel in the Gulf and proved absolutely essential in certain specialties. For example, one-third of all air reservists mobilized were medical personnel. While fewer in number, the Reserves comprised large percentages of both strategic and tactical airlift and air refueling crews and two-thirds of the Air Force communications personnel deployed. Three of the fighter squadrons in the Gulf were from the Reserves—two F-16 squadrons and one A-10 squadron. There probably would have been greater reliance on the Reserve components if not for the end of the Cold War. When the second phase of deployment took place in November 1990, the substantial forces in Europe, both Air Force and Army,

²²*Operation Desert Shield Problems Encountered by Activated Reservists*, "Report to the Assistant Secretary of Defense for Reserve Affairs," United States General Accounting Office, Sep 1991 (GAO/NSIAD-91-290), pp 1-2.

²³"The Contribution of the Reserve Components to the Persian Gulf War," in *The Reserve Components of the United States Armed Forces*, Jun 1992, p 40.

were available for redeployment, since no Soviet threat existed. By January 1991, over half of the aircraft of U.S. Air Forces Europe were in the Gulf or Turkey ready to support Desert Storm. As a result, fewer reservists were needed than would have been the case several years earlier for a similar deployment. Thus, the Air Force elected to call up only about 65 percent (34,000) of the total number (52,000) authorized by the President, percentages similar to those of the other Services.

Finally, the call-up of Reservists and selection of Air Force personnel to deploy tended to mask rates of those not able to deploy. Since entire units were not deployed, commanders could pick from volunteers and select those most fit for combat duty. The Air Reserve, for instance, reported no nondeployable personnel. Also, based on Air Force surveys conducted in September 1990 and February 1991, only 1.7 percent of the military couples with dependents were deployed, but a far higher percentage of single member sponsors (of dependents) deployed—13.3 percent. Women make up 15 percent of the Air Force, but only 7 percent deployed. The most likely explanation is that Air Force functional specialties that did deploy (crew members, maintenance, and security police, for instance) had a lower percentage of women than overall Air Force percentages. In the early stages of the deployment, there was some indication that women were not deploying on the first aircraft, waiting for clearer indications of the Saudi position on U.S. Service women, but that concern was soon dismissed.

The Intangibles

American air commanders brought to the theater experience and expectations that shaped the war as powerfully as any material piece of equipment. Two wars in particular had shaped their attitudes. One, the Southeast Asia conflict, seemed to offer cautionary lessons to Gulf War colonels and higher who had participated in it two decades earlier. The second was a war with the Soviet Union that never took place but that nearly all members of the armed forces had trained for assiduously, preparing air forces in various and generally useful ways for the air campaign against Iraq.

During Desert Shield, U.S. planners and commanders thought a great deal about their previous warfare experiences. They cautioned one another about the mass housing of U.S. troops in Saudi Arabia, fearing a repeat of the Beirut bombing of 1983. They refrained from fixating on the removal of Saddam Hussein as a war objective, bearing in mind the frustrating hunt for Manuel Noriega in 1989. No experience from their collective past, however, compared with the lessons from Vietnam. Colonel Warden and his Checkmate staff in the Pentagon referred to their draft plan for a campaign against the Iraqis as "Instant Thunder"—a not-so-subtle repudiation of

"Rolling Thunder," the initial air campaign in Vietnam. Vietnam-era commanders had taken part in a campaign of gradual escalation tied to theories of diplomatic bargaining stretching out over months; Gulf War commanders hoped to strike decisive blows in a war that might last only a week or two. Warden's codename for the plan did not survive, but many planners in Washington and the theater accepted this concept wholeheartedly. Civilian decisionmakers, no less than soldiers, had in mind a host of Vietnam-era lessons; in particular, they willingly let the military design the campaign in accordance with broad political guidance from the White House.²⁴ During the Vietnam War, U.S. politicians directed the military to use force incrementally, in a restricted fashion, and for ambiguous political objectives. Against Iraqi forces, civilians allowed the massive use of force, with few constraints (aside from those dictated by the laws of war and common sense) and for clear purposes. Washington headquarters did not micromanage the Gulf War, targeting suggestions were sent to the theater, but theater commanders ran the war.

Such, at any rate, was the view among the civilian and military leadership. In truth, the distinction between the conduct of the Gulf and the Vietnam Wars was in certain respects overstated. The restrictions imposed on the use of air power in North Vietnam, for example, were shaped considerably by a fear of igniting a broader war, with Chinese or Soviet intervention—a concern wholly absent in the Gulf. Political guidance for the use of air power in South Vietnam created considerably fewer constraints than in the North. In addition, in the Gulf War, targeting of downtown Baghdad changed following the bombing of the Al Firdos bunker on 13 February. In the two weeks preceding that incident, F-117s hit twenty-five targets in downtown Baghdad; in the two weeks after, they struck only five, very carefully chosen.

The political objectives in the Gulf War were, in important respects, ambiguous as well; the Presidential goal of securing a stable Persian Gulf could mean many things. Commanders could not know for certain just how much value they should place and how much effort they should direct on the destruction of the Ba'ath regime and the rule (if not the person) of Saddam Hussein. These qualifications notwithstanding, however, planners were undoubtedly correct to see a tremendous difference from the conduct of the Vietnam war.

²⁴H. Norman Schwarzkopf, *It Doesn't Take a Hero* (New York: Bantam Books, 1992), p. 320; Bob Woodward, *The Commanders* (New York: Simon and Schuster, 1991), pp. 324, 339, 347.

If memories of Vietnam explain some of the predilections of commanders—to strike massively and for limited but clear political objectives—it also explains some of their aversions. Commanders would not countenance, for example, "body counts" of Iraqi soldiers killed, an unwillingness that persisted in postwar reporting. Recollections of Vietnam may help explain as well the intention of air campaign planners to deny the enemy sanctuaries, at any rate in his own territory—the Coalition waged war throughout the length and breadth of Iraq from the first night. And memories of Vietnam help account for the unwillingness of General Horner and his subordinates to endorse anything that might resemble the "route package" system used in Indochina, which divided the enemy country into sectors assigned to particular air forces.

Decades of intense preparation for war in Europe also shaped operations in the Gulf. Such practices as low-level attack, which had been standard in Europe, were partially reflected in prewar training and in the first several days of operation in the Gulf. More importantly, the entire tactical system—the assembly of force packages, escorted by specialized SEAD (suppression of enemy air defense) aircraft—reflected American practice in Europe. So too did the definition of key missions; CENTAF planners referred to attacks against strategic targets as "interdiction," in keeping with the absence of any other category of deep targets in Central Europe. Many of the personnel and units assigned to CENTAF came to the theater from Europe, and of course, European-based units operated out of Turkey during the war.

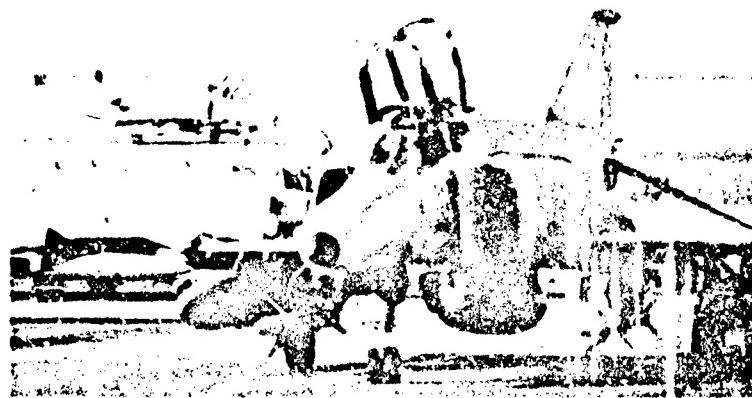
Above all, the constant international cooperation required for a European war had well prepared American forces to lead an international Coalition and to operate within it. All of the major Coalition partners had trained extensively with American units, which had become accustomed, in turn, to dealing with other nationalities. Such practices as the creation of a common air tasking order were routine for all concerned, and pilots used English as the common language. Commanders and staffs had rehearsed many large-scale air operations, and although Desert Storm was far larger than any exercise, it resembled the kind of effort that would have taken place in a European war. On a more tangible level, Coalition air forces, to a great degree, flew the same types of aircraft and used similar munitions and spare parts. Not all the commonalities offered advantages, however. Because France, Kuwait, and Iraq all flew French F-1 aircraft, identification procedures seemed chancy, and the Coalition restricted their use during the war.

In some important respects, Desert Storm posed a different challenge than did the Soviet threat to Europe. The Warsaw Pact had many small

air bases in Eastern Europe; the Iraqis had far fewer but much larger bases, which complicated runway cutting operations, for example. Weather posed far greater problems in Europe than in the Gulf. NATO planners anticipated far more resistance from Warsaw Pact air forces and air defense units than the Iraqis would eventually offer, and the terrain in the Gulf favored air power far more than did Eastern Europe. Above all, air forces in Europe anticipated a very different mission than they would undertake in the Gulf where the Coalition was able to initiate the air campaign. In Europe, air power would delay and disrupt onrushing Warsaw Pact attacks; in the Gulf, it would serve two very different purposes: it would conduct strategic attacks against an enemy's homeland and destroy a dug-in army on the defensive, not moving forward.

Coalition air forces contended with some difficulties adapting to the different circumstances. American munitions had been acquired primarily for a European war, and some of the initial estimates of Iraqi attrition rested on calculations of what might happen, for example, to moving armor that was attacked using aircraft-delivered mines—munitions less effective against a static opponent. Few units had practiced extensively for medium-altitude attacks, with the result that efficiency dropped when such attacks became the norm after the third day of the war. On the whole, however, Coalition forces used the five and a half months of crisis before the war well, adjusting to technical challenges posed, for example, by the use of infrared navigation and targeting systems over the peculiar terrain and the special climactic conditions of the Persian Gulf.

Perhaps the greatest intangible attribute brought to the Gulf by American commanders, in the air as on land, was supreme confidence in the ability of their troops and the quality of their equipment. They had spent the last two decades training for a far sterner test than the one they would now face, and although few individuals outside the military (and not all that many within it) understood the full extent of Coalition superiority vis a vis the Iraqis, few doubted that the war would end other than with a crushing Coalition victory. This mood of confidence mixed with a deep sense of determination—and the logs of the Tactical Air Control Center show this vividly—that this war would wipe clean the memory of the half-hearted efforts and mishaps of Vietnam and other occasions on which air forces had achieved less than their advocates had hoped. Many officers expected and desired that this war would, in some fashion, settle an open account in the history of air power.



F-4Gs carrying high-speed antiradiation missiles (HARMs).



KC-135

F-117



Laser-guided bombs being loaded on A-6Es onboard
the carrier John F. Kennedy.

Which Technologies Worked?

The uniqueness of a war is partly reflected in its characteristic technologies and equipment. Gen. Dwight D. Eisenhower and his staff identified what they believed were the five most important pieces of equipment contributing to success in Africa and Europe. Eisenhower speaks of them in his memoirs:

. . . the "duck," an amphibious vehicle . . . proved to be one of the most valuable pieces of equipment produced by the United States during the war. . . . [F]our other pieces of equipment . . . [that] came to (be) regarded as among the most vital to our success . . . were the bulldozer, the jeep, the 2½ ton truck and the C-47 airplane. Curiously enough, none of these is designed for combat.¹

The uniqueness of the Gulf War can be approached in a similar way by looking at five kinds of technology—not always single pieces of equipment—that seem to best characterize the air campaign. The number five is of course arbitrary and was chosen simply to limit the discussion and, in part, to mirror the Eisenhower example. We selected five capabilities and technologies from a longer list of candidates, any one of which could arguably have been included in the top five. Space systems, logistics, and strategic and tactical airlift were just a few of the candidates. Unlike Eisenhower's list, however, the Gulf War listing focuses solely on the execution of the air campaign, not on the many worthy logistical and support elements that could have been cited. Note, too, that our selections are not intended to suggest that these technologies are the best or most important items of U.S. air power but only that they worked best in the Gulf War. The five topics chosen for discussion are Stealth/Low Observability, Laser-Guided Bombs, Aerial Refueling, the high-speed antiradiation missile (HARM), and the STU-III, a secure telephone.

¹Dwight D. Eisenhower, *Crusade in Europe* (New York: Doubleday and Company, 1948), pp. 163-64.

Stealth/Low Observability

Stealthy, low-observable platforms were the keystones of Coalition attacks against the Iraqi air defense system, leadership, and communications targets early on the first day of the war, even in heavily defended areas. Throughout the war, they attacked with complete surprise and were nearly impervious to Iraqi air defenses. Stealthy platforms needed minimal support from other aircraft but were able to provide stealth to a much larger force by disabling the enemy's air defense system, thus making all Coalition aircraft harder to detect and attack.² Stealth thus not only restored a measure of surprise to air warfare, it provided air forces some freedom of action that otherwise would not have been attainable.

U.S. forces used three platforms during the Gulf War that were in the stealth/low-observability category: the F-117 stealth fighter³ and two long-range cruise missiles, the Tomahawk Land Attack Missile (TLAM) and the Conventional Air-Launched Cruise Missile (CALCM). Neither cruise missiles nor the stealth fighter figured in the deployment plans envisioned in pre-Desert Shield or Operations Plan 1002-90, but they became vital parts of the strategic air campaign. The F-117, which flew only two percent of the total attack sorties, struck nearly forty percent of the strategic targets and remained the centerpiece of the strategic air campaign for the entire war. Two hundred and eighty-eight TLAMs were launched during the war, sixty-four percent in the first two days of the air war and none after 1 February. Only thirty-five CALCMs were employed, all launched from B-52s on the first day of the war.

Low observability made possible direct strikes at the heart of the Iraqi air defense system at the very outset of the war. In the past, air forces fought through elaborate defenses and accepted losses on their way to the target or rolled those defenses back. In the Gulf War, the Coalition could strike Iraqi air defenses immediately, and they never recovered from these initial, stunning blows. With the combination of stealth and accuracy

²Low observability as a design and engineering goal involves the systematic reduction of observable signatures in various spectra, including, but not limited to, radar. The design of stealthy aircraft like the F-117 focused on reducing radar signatures because radar-based air defenses have long posed the greatest threat to air operations. Strictly speaking it is the combination of low observability and tactics that produces stealth in an operational sense. During this discussion, however, these terms will be used somewhat interchangeably.

³In some ways it is incorrect to call the F-117 a fighter—it is really a single-seat bomber.

possessed by the F-117 and cruise missiles, these two platforms carried out all attacks against downtown Baghdad; the F-117 operated at night, and the TLAMs during the day. Given American sensitivity to casualties—our own and Iraqi civilians—they were ideal weapon systems for attacking targets in the heart of a heavily defended, heavily populated city. Moreover, the F-117 had a psychological utility that was probably shared only by the B-52. Both were aircraft of a kind that only a superpower could have, and both could deliver destruction with no advanced warning—small wonder, then, that both figured prominently in psychological operations pamphlets that were showered upon Iraqi troops.

On the other hand, the F-117 and long-range cruise missiles also had limitations: both were less flexible and considerably more expensive than most conventional systems. The F-117, a subsonic, light bomber, had to operate at night to maximize stealthiness, and nearly nineteen percent of the strikes attempted by F-117s were adversely affected by weather (misses or no drops).⁴ While not as sensitive to weather conditions as the F-117, cruise missiles had a smaller payload, required a lengthy targeting process, and could not be retargeted after launch. Even without the flexibility of other aircraft, however, these platforms were able to set the terms for air operations over Iraq and to bring the reality of the war home to the residents of Baghdad.

Laser-guided Bombs

Few scenes were as vivid on television as the picture of a guided bomb going through a ventilation shaft in an Iraqi office building. From all appearances, a new age of precision bombing had supplanted years of employing less accurate, unguided bombs. In fact, the new age had only partly arrived: laser-guided bombs (LGBs) achieved dramatic success in the war, in some measure because of the early neutralization of Iraqi air defenses, but overall, laser-guided bombs comprised only a small fraction of the munitions expended in the war.

Laser-guided bombs are simply general-purpose bombs with guidance kits added—computer control and guidance canards in the front to detect laser energy and give steering commands and a wing assembly in the rear to provide lift. Laser-guided bombs are part of a larger family of precision-guided munitions (PGMs), many of which (air-to-air missiles, for

⁴See GWAPS, *Effects and Effectiveness*, App I. The F-117 database contained more than 400 weather-related misses or no-drops. Equivalent data were not available for other aircraft.

instance) have been around for over 30 years. Radio-guided bombs were used in World War II and Korea, and the Air Force dropped over 4,000 LGBs on North Vietnam during the period April 1972 to January 1973, targeted almost exclusively against bridges.⁵ In the Gulf War, more than 17,000 PGMs were expended, of which 9,342 were LGBs; 5,448 were air-to-surface missiles (predominantly Mavericks); 2,039 were antiradiation missiles (predominantly HARMs, discussed later); and 333 were cruise missiles (see above). By way of comparison, approximately 210,000 unguided bombs were dropped in the Gulf War.

What, then, explains the wartime prominence of LGBs, a not-so-new weapon that comprised less than five percent of the total weapons employed? There are three reasons, one of which has been noted—the marriage of LGBs and imaging infrared target sensors with stealth in the F-117. The stealth characteristics of the F-117 made the normally high-risk tactic of directing the path of an LGB while flying in a heavily defended area a much more routine affair. Any target in Iraq became open to destruction by the F-117's GBU-27, a 2,000-pound bomb designed to penetrate hardened facilities. A second reason for the importance of LGBs was Iraq's extensive system of hardened bunkers and aircraft shelters that were vulnerable only to a precision bomb with a penetrating warhead; it was vital that these targets be destroyed, and the LGBs were the only option for doing so. And third, LGB attacks were needed to attain attrition of the heavily revetted Iraqi armor in the Kuwait theater.

Laser-guided bombs were particularly effective because their employment came as something of a surprise to the Iraqis. Their reaction is understandable, because the LGB performance also surprised the United States. The one new U.S. weapon system prepared to drop LGBs was the F-117, an aircraft whose existence had been kept secret until just a year or two before the Gulf crisis and whose capabilities were largely unknown. Its one publicized employment had been in the Just Cause operation in Panama; in that conflict, the F-117's main notoriety came from a dispute on whether its LGBs, deliberately aimed to miss a building, missed by the correct amount. The U.S. fighter bombers designed in the 1970s, the F-16 and F/A-18, could not laser designate, and the first squadron of F-15Es received laser-designating equipment only after deploying to the theater, as did the RAF Tornados.⁶

⁵ Headquarters, Pacific Air Forces Summary, *Air Operations Southeast Asia*, monthly reports for May 1972 through January 1973.

⁶See Chapter 7 for a discussion of all aircraft capable of laser designation.

Laser-guided bombs carried principally by F-117s and F-111Fs were planned for precision air attacks on nearly the entire Iraqi target structure: air defense operations centers; national leadership and military headquarters; communications nodes; nuclear, chemical, and biological weapons research and storage facilities; and bridges were the most prominent. Beyond this planned use, much of the LGB employment was unplanned, growing instead out of adaptations made in the midst of the air campaign. Originally, the Coalition intended to destroy the Iraqi Air Force when its aircraft rose to meet the Coalition attacks. When the Iraqi aircraft instead remained on the ground in hardened shelters, Coalition aircraft shifted the attacks to the nearly 600 shelters themselves. Only weapons with the accuracy of LGBs and with hardened warheads, often dropped two at a time, were able to penetrate the reinforced concrete of these shelters. The results of these attacks were the flight of much of the Iraqi Air Force to Iran and the dispersal or destruction of the rest.

In the Kuwait theater, CENTAF turned to the use of LGBs when the planned air attacks on Iraqi armor with cluster munitions or unguided bombs proved to be largely ineffective. Iraqi revetted armor was simply less vulnerable to these munitions, particularly at the bombing altitudes used by the Coalition. The use of F-111Fs, F-15Es, and A-6s carrying 500-pound LGBs against the dug-in Iraqi armor was one of the major innovations of the war and marked a major turning point in the attrition operations against the Iraqi Army. This episode was an excellent example of the flexibility of the weapon, the aircraft, and the organization in dealing with the unexpected.

Laser-guided bomb employment also had limitations. Laser designation was not possible through overcast skies, fog, or smoke. The designating aircraft also had to remain in the target area and within line of sight of the target until bomb detonation. On the one hand, LGBs opened up new targeting possibilities: without them, systematic attacks on a communications system would have been unlikely simply because the probability of disabling a telephone switch or an antenna would have been too low without an excessive number of sorties; second, targets that would have been considered lucrative and vulnerable but too costly to attack were now open to assault. On the other, LGBs were of less value against large area targets, such as supply depots or deployed forces, without a single key node to attack. Against the key Iraqi targets in this war, LGBs were as devastating to the Iraqis as they were unexpected.

Air Refueling

Air refueling between aircraft took place well before World War II and has been a part of normal U.S. air operations since the 1950s. During the Gulf crisis, it was absolutely essential both to the deployment and to the war itself. Some aircraft required as many as 17 refuelings to deploy from the United States to the Gulf region. More than 100 tankers operated the Atlantic and Pacific air refueling bridges, permitting the rapid deployment of some 1,000 fighters, bombers, and support aircraft. During the war, Air Force tankers alone flew almost 17,000 sorties, usually with multiple receiver aircraft per tanker sortie.⁷

Nearly 60 percent of the wartime sorties by aircraft capable of being refueled in the air actually required tanker support. An elaborate network of air refueling tracks and anchors extended from the Red Sea across the Arabian Peninsula and into the Persian Gulf to support these requirements. This complex arrangement produced more than 60 air refueling tracks in which 275 tanker sorties per day operated, responding to the changing demands of the receiver aircraft. Liaison officers placed onboard the E-3 airborne warning and control aircraft managed the dynamic air refueling process, changing tankers from track to track to fill gaps as plans changed or emergencies developed.

The distances between Coalition air bases and targets meant that aircraft attacking deep into Iraq frequently had to refuel at least twice—once en route to the target and again on the return to home base. In some cases, refueling was conducted over Iraqi territory, an indication of the extent to which the Coalition controlled the air. Coalition air forces also relied on refueling to help them control the skies over the battlefield and strike into the enemy heartland. A list of representative aircraft and target areas shows the extent of the dependence:

<u>Aircraft</u>	<u>Combat Radius</u>	<u>Target Distance</u>
F-117	550 nm	to Baghdad—905 nm
F-15E	475 nm	to Western Scud areas—680 nm
F/A-18	434 nm	Red Sea Carrier to Kuwait City—695 nm
B-52G	2,177 nm	Diego Garcia to Kuwait—2,500 nm

⁷(S) HQ SAC, Plans and Requirements (XP), "Desert Shield/Desert Storm Tanker Assessment," 23 Sep 1991, p 2-13.

In addition to supporting Coalition attack aircraft, aerial tankers refueled combat air patrol aircraft and an entire array of airborne warning, reconnaissance, targeting, and control aircraft that had to provide 24-hour coverage during both Desert Shield and Desert Storm. Only aircraft such as A-10s and AV-8Bs, flying from the more forward operating bases and attacking targets in the Kuwait theater, could fly back and forth without in-flight refueling.

Air operations without the extensive support of aerial tankers would have changed the character of the war; by how much can only be guessed. Initial deployments to the theater would have been delayed, making more use of en route bases and requiring considerable logistical support at these bases. Because of the ranges to the targets, all dimensions of the air campaign would have been altered: the number of sorties a day as well as operating bases used. In short, the air campaign was designed with the assumption that all necessary tanking would be available, and a change in that assumption would mean a change in the design. Aerial tankers facilitated the speed and mass of the attacks and provided a margin of safety in air operations. Moreover, against an enemy capable of attacking air bases close to the border, the ability to refuel extensively permitted operations from distant, secure bases and provided a buffer of inestimable worth.⁸

HARM

Several air power weapons contributed to the Coalition's command of the air over Iraq and the Kuwait theater, but no single weapon was as significant as the high-speed antiradiation missile (HARM). The use of HARMs effectively neutralized both elements of Iraqi ground-based defenses—antiaircraft artillery (AAA) and surface-to-air missiles (SAMs)—by suppressing the SAMs and thereby allowing Coalition aircraft to fly above the lethal range of AAA. Other forms of countermeasures to Iraqi radars (jamming, in particular) were important, but the HARM was the chief lethal component of the effort to suppress enemy air defenses.⁹ The HARM homed in on Iraqi radar emissions and destroyed the emitter, and it was launched from a variety of platforms, most notably the F-4G "Wild Weasel" aircraft. The U.S. Air Force fired some 1,067 HARMs, and the U.S. Navy and Marine Corps fired 894. Combined with the destruction of Iraqi air defense control centers and of Iraqi aircraft in the air and on the ground, overall air defense suppression resulted in an attrition rate for Coalition aircraft of less than a tenth of that incurred by

⁸Chapter 7 has further discussion on aerial refueling operations.

⁹Other lethal missiles that homed in on Iraqi radars included the British ALARM and the older American Shrike system, of which fewer than 200 were launched.

the United States operating over North Vietnam during the Linebacker II campaign of 18 to 29 December 1972.¹⁰

Although most of the HARMs were fired during the first week of the war—200 on the first night—they continued their influence throughout the war. On the first night of the air war, an elaborately choreographed combination of stealth aircraft, specialized electronic warfare aircraft, decoys, cruise missiles, and attack aircraft delivered a sudden, paralyzing blow to the integrated air defense system from which the Iraqis never recovered. The HARM's role was to take out the Iraqi SAM radars, activated by the decoys and attack aircraft. As important as the ability of HARM to actually destroy Iraqi radars was its deterrent effect: after the first day of the war, Iraqi radar activity declined precipitously because of the unwillingness of operators to turn on their radars for anything more than brief periods of time. Iraqi operators would, in fact, turn off their radars if they knew a HARM-carrying aircraft was in the vicinity. This was a classically indirect effect of a weapon; a measure of HARM's physical destruction of enemy targets tells only part of the story. By the third day of the war, the radar threat had been so reduced by the Iraqi fear of HARMS that the Coalition could fly at altitudes of 10,000 feet or higher, where normally radar-guided SAMs would have posed an unacceptable threat.

The experience of the 35th Tactical Fighter Wing (Provisional), whose F-4G aircraft were the main employers of HARM, indicates how the dominance over SAMs came about. The 35th Wing fired 905 HARMs and recorded 254 radars destroyed, for a 28 percent success rate. More significant, however, was that the radars, if not destroyed, had virtually ceased to operate. The F-4Gs that accompanied strike packages invariably fired all their missiles during the first week of the war; later, some of these aircraft returned with all of their missiles. In the Kuwait theater, the F-4Gs began a patrol, the "Weasel Police," so that they no longer accompanied each strike package, but each element of the F-4Gs could cover thirty to forty attack formations. Later in the war, the dominance became so complete that tanker aircraft could accompany the F-4Gs further north, allowing them to remain on-station even longer. During the entire war, only five Coalition aircraft were lost to Iraqi radar-guided SAMs, and four of those five did not have F-4G support.¹¹

¹⁰Linebacker II losses were 25 aircraft out of about 3,200 combat sorties, compared to 38 losses out of about 70,000 combat sorties in the Gulf War.

¹¹(S) TSgt Charles L. Starr, *History of the 35th Tactical Fighter Wing (Provisional), Operations Desert Shield and Desert Storm, 2 August 1990 - 2 August 1991, Volume I* (35th Fighter Wing Special History), pp 148-50, 179-83, 190.

STU-III

The Secure Telephone Unit (STU) III was an essential item of support equipment for the units that deployed to the Persian Gulf region. Over 350 STU-III's were used in the area of operations alone. This unit and the associated family of secure facsimile machines and field phones enabled air campaign planners and staffs to preserve operational secrecy and still establish the informal and ad hoc organizations that sprang up to conduct the campaign.¹²

Campaign planners communicated regularly with agencies in Washington and with deployed wings, frequently bypassing intermediate theater-level organizations. The STU-III and secure fax created the potential for a tremendous volume of communication between parallel groups in the theater and the United States, dealing with everything from the selection of targets to the status of various spare parts or key munitions. Traditional hierarchies and cumbersome procedures were bypassed, leading to improvisation and creativity on the one hand and confusion on the other.

Targeting and sortie production were affected in many ways. On numerous occasions, the Checkmate organization in the Pentagon worked with Washington intelligence organizations to develop prospective targets, then called or faxed the target identification, often including building or site diagrams, to the strategic planning cell in Riyadh. If the target was a high priority one, General Glossen might call a fighter unit on the same day and divert aircraft to this new target. A day later, another call from Washington could bring the first information on target damage. Significantly, the entire intelligence organization in Riyadh could be unaware of these actions until later, if at all. Similarly, adequate coordination with tanker, electronic countermeasures, and reconnaissance aircraft was at times omitted in these late targeting changes, with a resulting loss in sorties and effectiveness.¹³

Conditions in the theater made extensive use of secure telephones a necessity. In the early days of the deployment, the STU-III tied into the local commercial telephone system was one of the few communications capabilities available. Later, premission communications by a mission commander with elements of an attack package at distant bases still took

¹²Col Randy Witt, et al, "Air Force Tactical Communications in War: The Desert Shield/Desert Storm Comm Story," Hq CENTAF, Mar 1991, GWAPS, NA 49; Hq TAC DCS Communications-Computer Systems, "Desert Shield/Desert Storm After Action Report," 16 Jul 1991, GWAPS, NA 180.

¹³See Chapters 2, 4, and 5.

place by secure telephone; so too did subsequent coordination on changes to call signs, times, radio frequencies, and so forth.

The daily air tasking order (ATO) grew to hundreds of pages and was laboriously transmitted over the Computer Assisted Force Management System (CAFMS), but most units had already received the ATO information that pertained to them via secure telephone from Riyadh long before the ATO was sent electronically. Some units avoided CAFMS entirely by arranging for electronic transmission of the ATO from personal computer to personal computer over the voice network through STU-IIIIs. The Black Hole also used this technique to transmit master attack plans to Checkmate. The down side of using STU-IIIIs for data communications was the pressure put on voice circuits.¹⁴

Although callers (who would have liked more secure phones and lines) often had trouble "going secure," the STU-III came to symbolize the aspects of computers and telecommunications that worked best. The great promise of these intertwined technologies was only partly realized in this war. CAFMS was by no means the only computer-communications system to prove inadequate under the demands of Desert Shield and Desert Storm. While the American military led other armed forces in its use of computers, the rapidity of technical change had left many of its systems out of date even before they were fully developed. Older mainframe systems were only beginning to acquire the hardware and software necessary for integrated databases and distributed processing.

Problems with mainframe systems, exposed immediately at the beginning of the crisis in August 1990, required even more extensive use of secure phones to overcome efficiency breakdowns. Because the Iraqi invasion came while CENTCOM was still developing an operations plan for that contingency, the Joint Operation Planning and Execution System (JOPES) did not have the necessary data to help commanders schedule the deployment. JOPES was itself undergoing hardware and software development and was not ready to manipulate rapidly changing deployment data fast enough to meet CENTCOM's demands. JOPES ran on the Worldwide Military Command and Control Systems's old Honeywell mainframe computers acquired in the 1970s; it was supposed to integrate separate databases for peacetime planning and crisis planning. JOPES' problems, however, extended beyond its transitional condition to a shortage of personnel trained to operate in this evolving system. For weeks, manual calculations, person-

¹⁴See Chapter 5.

al computers, and telephones had to work around JOPES to get American forces deployed to Southwest Asia.¹⁵

Computer system after computer system followed the sorry pattern of JOPES' performance. Military Airlift Command did not have enough time to schedule missions using its Flow Generation (FLOGEN) model and resorted to personal computer spreadsheets.¹⁶ The Combat Ammunition System was still under development, and the version used by Tactical Air Command, U.S. Air Forces in Europe, and Pacific Air Forces did not have sufficiently accurate data to be helpful. As for the larger problem of tracking supplies in general, the interim solution of having each deployed unit linked to the supply computer at its host base in the United States never worked well. The precrisis plan to deploy mainframes to the theater for supply accounting gave way eventually to linking as many deployed units as possible to Tactical Air Command's Unisys computer at Langley Air Force Base, Virginia. Achieving that arrangement, however, took the better part of Desert Shield's five months and innumerable STU-III calls.¹⁷

The STU-III, like the other four technologies featured in this chapter, hit its stride in the Gulf War. For the most part, these technologies were not really new and were available in less sophisticated forms during the Vietnam War. Thousands of laser-guided bombs were dropped on North Vietnam, together with even more numerous radar-seeking missiles; bombing missions from Thailand depended on air refueling to reach the Hanoi-Haiphong region; and the bases scattered around Thailand coordinated strike packages over the telephone. Some other technologies went through more dramatic changes after the Vietnam War. Airborne radar, for example, came into its own first with the Airborne Warning and Control System and then (just in time for the Gulf War) with the Joint Surveillance Target Attack Radar System. If Iraq's air force and army had been more active, these radar systems would have played a more central role. All of which raises the question: how revolutionary was the air campaign against Iraq?

¹⁵JULLS 91055-65325 (00141), Hq MAC CAT Director; JULLS 91154-50811 (00109), USCENTAF Rear/LG.

¹⁶Lt Gen Vernon J. Kondra, *Operation Desert Shield - Desert Storm: The Vernon J. Kondra Notes* (McGuire AFB, 1992). Kondra was at Hq MAC DCS Plans and later DCS Operations.

¹⁷Intvws, GWAPS with Col Mike Christensen, 18-20 Nov 1992; Col Van McCrea, 4-5 Apr 1992; and Frank Spruce, 22 Oct 1992, all at Langley AFB.



**JSTARS radar display showing vehicle traffic of the Iraqi Army
fleeing Kuwait and on the roads to Basra.
(Photo courtesy of Grumman Corp.)**

Was Desert Storm a Revolution in Warfare?

Many circumstances in the Gulf War overwhelmingly favored the United States and its Coalition allies. The end of the Cold War meant that they could concentrate their vast military forces almost exclusively on the war against Iraq. The terrain and Iraqi force structure favored the effective application of air power. Underestimating American capabilities and resolve, Saddam Hussein conceded the initiative and gave the U.S.-led Coalition the time to marshal and prepare forces for battle.

Notwithstanding these strongly favorable circumstances, the extraordinarily lopsided quality of the war in general and of the air campaign in particular has led a number of observers to conclude that the war's conduct and outcome augur a revolution in the conduct of war, a transformation of warfare itself. The popular arguments for this conclusion have taken two forms. The first sees the Gulf War as evidence that technology has finally enabled airmen to fulfill the expectations that air power advocates advanced in the 1920s and 1930s. Air power proponents such as Giulio Douhet and Billy Mitchell had described the things that air power could achieve in theory, but until the Gulf War, air forces lacked the "tools and systems capable of achieving them" in practice.¹ The second line of argument interprets Desert Storm as confirming the decade-old Soviet prediction of an impending "military-technical revolution" driven by advances in microelectronics, automated decision-support systems, telecommunications, satellite and other advanced sensors, lasers, and, especially, nonnuclear munitions so accurate and lethal that they could wreak levels of military damage comparable to those attainable with tactical nuclear weapons.²

¹Lt Col David A. Deptula, "Can Bombing Win a War?," NOVA Show #2002, air date 19 Jan 1993, Journal Graphics transcript, p 6.

²Mary C. Fitzgerald, "The Soviet Image of Future War: 'Through the Prism of the Gulf War,'" Hudson Institute HI-4145, May 1991, pp 4, 66-67; Intvw with Marshal N. V. Ogarkov, "The Defense of Socialism: Experience of History and the Present Day," *Krasnaya Zvezda [Red Star]*, 9 May 1984, English trans. FBIS, *Daily Report: Soviet Union*, 9 May 1984, Vol II, No 091, Annex No 054, p R 19. Also see Benjamin S. Lambeth, "Desert Storm and Its Meaning: The View from Moscow," RAND R-4164-AF (Santa Monica, CA: RAND, 1992) and Mary C. Fitzgerald, "The Soviet Military and the New 'Technological Operation' in the Gulf," *Naval War College Review*, 44:4 (Autumn 1991), pp 16-43.

The first argument, that this war confirmed the prophecies of air power theorists from the inter-world-war period, tends to overlook how the results envisioned by the earlier theorists differ from those envisioned by the architects of the Desert Storm air campaign. Air power thinking between the wars took its character from a revulsion against the experiences of World War I and from assumptions about the requirements of industrialized warfare. During the 1930s, the U.S. Army's Air Corps Tactical School espoused precision bombardment of "vital targets" in the "industrial web" of an enemy nation in order to deprive it of the means of mass production required to prosecute modern war.³ The School's theory of strategic bombardment sought disorganization and paralysis of the enemy nation through selective attacks on critical industrial targets.⁴ In these respects, the Tactical School approach differed from the theories of Douhet, who advocated mounting all-out attacks with high-explosive, incendiary, and poison-gas bombs on the enemy nation's population and industrial centers in order to compel surrender.⁵ Douhet's theories anticipated the collapse of an opponent's society as a result of attacks far more brutal (deliberately against civilians) than any American commanders or politicians today would willingly contemplate. But even if one focuses on the industrial bombing approach of the Tactical School rather than the theories of Douhet, the short, intense air campaign of the Gulf War had a different emphasis than did the air power prophecies of the 1920s and 1930s. In contrast to attacking the industrial production that in past wars had provided the arms and munitions for forces in the field, the Desert Storm air campaign sought preeminently to disorganize the "central nervous system" of the enemy regime.

³Maj Gen Haywood S. Hansell, Jr., *The Air Plan That Defeated Hitler* (Atlanta, GA: Higgins-McArthur/Longino and Porter, 1972), pp 40-48. The theory of strategic air attack described by Hansell was implemented in an August 1941 plan designated AWPD-1 (Air War Plans Division-1) as well as in the plan for the Combined Bomber Offensive against Nazi Germany. During Desert Shield, Col John Warden put up a sign outside the Checkmate spaces in the basement of the Pentagon that read: Air War Plans Division 1941-1991.

⁴Donald Wilson as cited in Hansell, *The Air Plan That Defeated Hitler*, pp 40-48. Hansell, Wilson, Kenneth N. Walker, Laurence S. Kuter, and Harold L. George are generally considered to have been the main architects of the theory of strategic air attack that came to predominate at the Air Corps Tactical School by the mid-1930s.

⁵Giulio Douhet, *The Command of the Air*, trans. Dino Ferrari (Washington, DC: Office of Air Force History, 1983 imprint of 1942 translation of 1927 2d ed), pp 58, 187-195, 281. Mitchell's position fell between those of Douhet and the Air Corps Tactical School. See William Mitchell, *Winged Defense* (New York: G.P. Putnam Sons, 1925).

The Soviet argument for a dawning revolution in military affairs focuses less on military hardware catching up with longstanding doctrinal promises than on technological advances making qualitative transformations in nonnuclear, or "conventional," warfare. Soviet theorists have argued that in the near future, so-called "reconnaissance-strike complexes" would enable commanders to detect targets and attack them effectively, at long ranges, and within minutes. These combinations of sensors and weapons would blur traditional distinctions between offensive and defensive fires and allow the conduct of war over far greater distances than ever before. Given the use of advanced reconnaissance systems and precision munitions in the Gulf War, it was natural for Soviet observers, as well as like-minded American commentators, to conclude that "the integration of control, communications, reconnaissance, electronic combat, and delivery of conventional fires into a single whole" had been realized "for the first time."⁶ Close examination of the evidence, however, suggests that this conclusion went too far. Although many of the pieces of "reconnaissance-strike complexes" were present in Desert Storm, Coalition forces did not integrate them on a large scale. For example, to direct the use of precision bombs, Coalition commanders relied on an air-tasking system whose cycle times and use of advanced reconnaissance sensors had not changed appreciably from the Vietnam era. Episodes such as using JSTARS to detect Iraqi forces moving up for the attack on Al Khafji at the end of January were important exceptions, but exceptions nonetheless. Despite the presence of airborne, space, and ground sensors, many mobile Scud launchers still managed to elude the Coalition's best attempts at their destruction.

Yet, while neither of these popular arguments for a revolutionary advance matches precisely what occurred in the Gulf War, the facts of Desert Storm do require further consideration. If nothing else, the one-sided character of the war demands explanation. Why was the Coalition able to smash an army of hundreds of thousands of men and thousands of tanks, artillery pieces, and vehicles at a cost of fewer than 200 men killed and fewer than 50 aircraft lost? Why, moreover, did so few expert observers in the United States and elsewhere anticipate such lopsided

⁶"Soviet Analysis of Operation Desert Storm and Operation Desert Shield," LN 006-91, trans. Defense Intelligence Agency, Washington, DC, 28 Oct 1991, p 32. For an example of American defense analysts who reached much the same conclusion regarding the realization of "recce-strike complexes" in Desert Storm, see Ashton B. Carter, William J. Perry, and John D. Steinbruner, "A New Concept of Cooperative Security," Brookings Occasional Paper (Washington, DC: Brookings Institution, 1992), p 3.

results? And why did the war look so different from the conflicts of the past few decades, in which air action served as a prelude and accompaniment to a bloody struggle on the ground?

What Do We Mean by a Revolution in Warfare?

The notion of periodic and radical changes in the conduct of war is an old one. Scholars have written of the military revolution of the seventeenth century and of the revolution brought about by the advent of the railroad, rifle, and telegraph in the middle of the nineteenth century. During the twentieth century one can identify at least two such dramatic changes in warfare. The first culminated in the period 1939-1942 with the appearance of *Blitzkrieg* (lightning warfare), strategic bombardment, offensive carrier aviation, and amphibious warfare. These developments depended in various ways on the technologies involved in mechanization, aviation, and radio communication. The second, which centered on the marriage of atomic weapons and intercontinental ballistic missiles, covered the period from the late-1940s to the mid-1960s and culminated in the fielding of large arsenals of ballistic missiles with nuclear warheads that were never used in anger.

In each case, revolutionary change in the conduct of war required the advent or maturation of new military technologies (e.g., the internal combustion engine, armor, etc.), their integration into new military systems (e.g., the tank or the long-range bomber), the adoption of appropriate operational concepts (e.g., the armored breakthrough and its exploitation), and finally, the requisite organizational adaptation (e.g., the *Panzer* division and the Clausewitzian approach to war embedded in the German troop regulations of that era.⁷ Technology alone does not a revolution make; how military organizations adapt and shape new technology, military systems, and operational concepts matter much more. In France and the low countries in May 1940, the British and the French had technology and military systems at least comparable to those of the Germans, and British tank enthusiasts such as J.F.C. Fuller and B.H. Liddell Hart had articulated the requisite operational concepts. But without the necessary organizational adaptation, the British and French were unable to withstand the German *Blitzkrieg*. More than the

⁷See Gen Ludwig Beck, *Truppenführung (Troop Leading): German Field Service Regulations*, Part I, trans. U.S. Army, report no. 14,507, 18 Mar 1936, pp 1-2. This way of thinking about military revolutions is based on work that has been done on the subject in recent years by Mr. Andrew Marshall, the Director of Net Assessment, Office of the Secretary of Defense.

inventions of clever technologists or the reflections of insightful theorists would be needed to make armored warfare successful; doctrine and organization played their part as well. Furthermore, politics—the purposes of war and the domestic pressures on its conduct—can also shape a revolutionary change in warfare.

It is therefore insufficient to look merely at the technologies of precision weapons, airborne radars, and datalinks and to declare the existence of a “military-technical revolution.” If history is any guide, the technologies necessary for such dramatic change may require much time and trial before armed forces can use them as effectively as theory might predict. We are probably still too close to the Gulf War of 1991 to draw definitive lessons from it about the nature of future war. Because the conditions under which Desert Storm was conducted were so special, the question posed at the beginning of this chapter will elude a definitive answer. We can, however, ask whether the *precursors* of a revolutionary change in the conduct of war appeared in this conflict. To answer that question, it makes sense to ask which elements of the conflict appeared to have precedents in earlier experience and which seemed new or radically different.

Things That Were Not Wholly New

Target Sets

With few exceptions, the planners of Desert Storm used the same target categories as in previous wars. In World War II, Korea, and Vietnam, aircraft attacked air defenses, fielded armies, oil refineries, electrical power grids, and, even command, control, and communications. In the Gulf War, the Coalition achieved successes against some of these target systems (especially strategic air defenses and electric power) extraordinarily quickly—what took a day or two to accomplish in this conflict might have taken months in others. But the concept of what to attack to disorganize and paralyze an enemy nation did not differ substantially from previous air campaigns. A partial exception to this generalization was the emphasis on targeting national-level leadership and telecommunications from the outset, rather than vital elements in enemy war production as had been the focus of the Combined Bomber Offensive of World War II. But a relatively small proportion of the Coalition effort (fewer than 1,000 strikes out of a total of about 42,000) went against this set of targets. Leadership attacks also had precedents, most notably in the fatal aerial ambush of Admiral Isoroku Yamamoto in April 1943.

Suppression of Enemy Air Defenses (SEAD)

The Coalition successfully shut down the Iraqi air defense system within days of the war's beginning. The operational achievement was impressive, but again, very little was new *in principle* about this aspect of the air campaign. Since 1943, American air forces have undertaken the achievement of air superiority as their first priority. As defenses (particularly surface-to-air missiles) have grown more sophisticated, the suppression of enemy air defenses has become an increasingly important part of that task.⁸ The measure-countermeasure struggle of World War II included electronic and physical means of jamming or confusing enemy radars, and radar-homing missiles have long been part of the arsenals of the United States and her allies. Direct attacks on enemy ground-based air defenses (as distinct from airfields) became common in the Vietnam War, when the advent of radar-guided surface-to-air missiles led to the creation of dedicated radar-hunter-killer aircraft, the Wild Weasels. In 1972, Linebacker II achieved considerable successes against North Vietnamese air defenses, albeit at greater cost than in the Gulf. Since then, virtually all large air operations have featured some SEAD operations. The Israeli operation in the Beka'a Valley in 1982 combined SEAD and air-to-air combat to defeat the Syrian Air Force and its ground-based air defense. Although on a much smaller scale than the Gulf War (the Beka'a is roughly half the size of one of the thirty-odd killboxes in the Kuwait theater), it exemplified the sophisticated use of a variety of means to take down an air defense system. The Gulf War operation departed from others in its speed, scope, and relative cheapness in terms of casualties. Coalition forces did not conduct SEAD as an isolated effort to protect a specific mission or area but rather as an integrated attack designed to disable the entire Iraqi national-level air defense system. The intimate cooperation of aircraft from different Services and nations in this effort also represented something of a departure from the past and testified to the benefit of centralized planning under a Joint Force Air Component Commander (JFACC).

⁸War Department, "Command and Employment of Air Power," Field Manual 100-20, 21 Jul 1943, p 1; "Basic Aerospace Doctrine of the United States Air Force," Air Force Manual 1-1, Vol 1, Mar 1992, p 10.

Precision Munitions

For many noncombatant observers, the most vivid images from the Persian Gulf War came from videotapes of laser-guided bombs hitting particular points on buildings and bridges with seemingly unerring accuracy. Yet, the use of precision munitions in general and laser-guided bombs in particular was not new. The Air Force used laser-guided bombs, for example, fairly extensively during the Linebacker operations.⁹ But it was the intensity of the operation more than the technology employed that represented a departure. Desert Storm saw in 6 weeks the dropping of more than double the number of laser-guided bombs released over North Vietnam in 9 months. Aircraft attacked a much broader range of targets than in the Linebacker operations, prosecuted the bulk of the attacks with these munitions at night rather than in the daytime, and used precision-guided missiles (most notably some 5,400 Maverick antiaarmor missiles and more than 2,000 HARM antiradar missiles) more extensively than ever before. Again, the war saw qualitative rather than a quantitative change in weapons employment.

Functional Effects

In the Gulf War, planners consciously sought functional effects; that is, they measured their success in terms other than pure destruction. It mattered little, for example, if bombs had leveled a sector operations center in the Iraqi air defense system. It would suffice if a couple of accurate and damaging hits had so intimidated the occupants that they abandoned the site. Similarly, if the pervasive presence of F-4C Wild Weasel aircraft deterred enemy radar operators from turning on their equipment, the physical destruction of those radars mattered little. Functional effects thinking led planners to assign fewer aircraft and fewer bombs to many targets, which in turn meant that they could attack more targets simultaneously rather than a few repeatedly and in depth. Although the capability to hit a wide range of targets simultaneously was new, seeking functional effects was not. Daylight bombing attacks on German aircraft production in the spring of 1944 to force the *Luftwaffe's* fighter arm into the skies to fight reflected a similar approach.¹⁰ Here too, the effect sought was a functional one that was, to some extent,

⁹See discussion of laser-guided bombs in Chapter 9.

¹⁰William E. Kepner, *Eighth Air Force Tactical Development: August 1942-May 1945* (England: Eighth Air Force and Army Air Forces Evaluation Board, Jul 1945), pp 76-77.

insensitive to the amount of physical destruction actually inflicted on German aircraft production.

Paralysis as a Goal

Finally, theorists had long argued that air power could disorganize and paralyze an enemy's military industries and operations, as Allied bombing of Germany sought to do in World War II. In the Gulf War, the Coalition's strategic-operational goal of the air campaign, particularly during the elaborately planned first two days, was more ambitious: to paralyze Iraqi national leadership by destroying its telecommunications, strategic air defenses, and air force. As described in Chapter 3, the Coalition achieved impressive successes, especially against Iraqi strategic air defense.

Operational Thresholds

The majority of the military systems and operational concepts central to the Desert Storm air campaign, then, had historical antecedents. Most of the technologies had seen service in earlier wars.¹¹ Even the low-observability (or stealth technology) of the F-117 was not new. The plane had first taken part in combat during Operation Just Cause in Panama on the night of 20 December 1989,¹² and stealth technology aimed at eluding radar-based air defenses had helped to protect the SR-71 for decades.¹³

But even if the technologies and concepts were not new, the ways in which Coalition air forces applied them often were. Moreover, as Soviet military theorists had long observed, quantitative changes in the conduct of war have a way of becoming qualitative transformations. It is not surprising, then, that knowledgeable observers, including a number of officers involved in the planning and conduct of the Desert Storm air campaign, concluded that they had witnessed something "revolutionary" in the Gulf War. In this war, air power crossed some operational thresholds that, if not as obvious as the initial use of a new weapon or opera-

¹¹JSTARS was an important exception.

¹²"Out of the Black," *Lockheed Horizons*, May 1992, p 51. This issue of *Lockheed Horizons*, subtitled "We Own the Night," was devoted entirely to the F-117 program.

¹³"Early F-117 Program Set Pattern for B-2, A-12, A-X; No Prototypes," *Aerospace Daily*, 11 Jun 1992, p 411; also Bill Sweetman, *Stealth Aircraft: Secrets of Future Airpower* (Oscoda, Wisconsin: Motorbooks International, 1986), pp 14-21.

tional concept, did suggest a transformation of war. The following examples illustrate this proposition.

Target/Sortie Ratios

Mission planners normally calculate the number of aircraft that would have to be sent against a given target to have a specified probability of destroying it with particular munition. Assuming unguided (or "dumb") bombs, they might have to send dozens or even hundreds of sorties to achieve a ninety percent or higher probability of destroying many kinds of targets. To cite an extreme example, the Thanh Hoa bridge in North Vietnam withstood literally hundreds of attacks during Rolling Thunder from U.S. Air Force and Navy fighter-bombers without sustaining major structural damage.¹⁴

In examining the sorties flown by F-117s and F-111Fs during Desert Storm, however, it quickly becomes evident that target/sortie ratios were dramatically different even from the Linebacker era, when large numbers of laser-guided bombs first saw combat use. To provide a sense of just how different, one can compare 12 representative sorties by F-117s and F-111Fs delivering laser-guided bombs with 12 sorties flown by Proven Force F-111Es delivering unguided Mk-82s (500-pound bombs). The 12 Proven Force sorties covered 2 targets (an AM radio transmitter and a sector operations center in Kirkuk) with 168 Mk-82s; by contrast, the dozen F-117 and F-111F sorties covered some 26 precision targets with a total of 28 bombs (mostly 2,000-pound weapons, but including some 500-pound GBU-12s for 2 tank-plinking sorties).¹⁵ The target/sortie ratio for the dozen dumb-bomb sorties was 1:6, whereas it was approximately 2:1 for the 12 precision sorties. Thus, the differential between the precision and nonprecision cases was $26/2 = 13:1$, or better than an order-of-magnitude difference. Moreover, the low-light laser-guided bombs of the

¹⁴The more than 350 U.S. Air Force and Navy strike sorties flown against the Thanh Hoa bridge from 1965-68 failed to drop a single span of this overbuilt structure, even though it was often rendered temporarily unusable [Col Glenn Griffith, et al, "The Tale of Two Bridges," *The Tale of Two Bridges and the Battle for the Skies over North Vietnam*, ed Maj A. J. C. Lavalle (Washington, DC: US Government Printing Office, 1976), pp 31, 38, 42-3, 46, 55-6, 59, 62-3]. USAF losses against the bridge over this period included F-105s, F-4s, and a C-130. During Linebacker I, two attacks involving a total of 26 F-4 sorties delivering laser-guided bombs finally succeeded in dropping the Thanh Hoa bridge without any aircraft losses (*ibid*, pp 84-6).

¹⁵The actual sorties selected for this comparison can be found in the second table in Chapter 7 of *GWAPS Effects and Effectiveness* report.

sort dropped during Desert Storm by the F-117s and F-111Fs had substantially higher probabilities of hitting individual point targets than dozens of unguided Mk-82s. Precision-guided weapon technology had improved considerably since the Vietnam War, a fact reflected in the superb performance of the GBU-27 guided bomb dropped by the F-117s. The success of air defense suppression by specialized aircraft such as the F-4G, the EF-111, and the EA-6B reinforced this capability, because now aircraft could fly at medium altitudes and designate their targets with more care than in the past.

Changes in the Vulnerability of Certain Target Classes

Throughout the history of air warfare, targets have had very different degrees of vulnerability to air attack. The speed of an attacking aircraft, the sophistication of its navigation and target identification systems, and the accuracy of its ordnance determined what aircraft could and could not do. It would not have occurred to air planners during World War II, for example, to think that one might systematically attack an enemy's entire telephone system, even if one could, on extraordinary occasions, conduct isolated precision attacks against pieces of it.

The Gulf War saw at least two classes of difficult targets—armored vehicles in revetments and very hard aircraft shelters—become vulnerable to air attack from medium altitude at night. Many experts assumed before Desert Storm that, save for an occasional lucky bomb, both hardened aircraft shelters like the Iraqi "Yugos" and main battle tanks in revetments would be virtually invulnerable to bombing attacks from fixed-wing aircraft. The integration of forward-looking infrared (FLIR) sensors with laser targeting devices aboard individual aircraft provided the accuracy and ease of employment necessary for systematic attacks against both classes of targets. The combination of the I-2000 hard-target-penetrating warhead and laser guidance kits meant that bombs could penetrate structures as hard as the Iraqi "Yugos" and destroy any aircraft inside. Given the degree of air superiority achieved early in Desert Storm by Coalition air forces and Iraqi reluctance to risk destruction of the Iraqi air force by contesting control of the air, Coalition airmen could conduct systematic campaigns of attrition against hardened Iraqi aircraft shelters and the armored vehicles of Republican Guard and other Iraqi ground units.

Whether combinations like the F-117 and GBU-27 will exert comparable dominance in future wars with different terrain or a more mobile adversary remains unclear. Only a more difficult test than the Gulf War could establish without question the supremacy of the precision-guided air-delivered bomb as the dominant weapon of war. Nevertheless, the shelter busting and "tank-plinking" that occurred in Desert Storm were qualitatively different from and superior to the laser-guided bombing effort of the last phase of the Vietnam war.

Stealth, Air Superiority, and Campaign Options

The F-117, in conjunction with unmanned precision weapons such as the Tomahawk Land Attack Missile (TLAM), gave Coalition air forces the wherewithal to attack a wide range of targets systematically, from the outset of operations. Above all, the Coalition could prosecute these attacks without first "rolling back" Iraq's air defenses. The "air superiority" built into the F-117 also allowed it to attack key elements of Iraq's strategic air defenses as an integral part of Coalition efforts to gain early control of the air. In effect, platforms like the F-117 provided low-risk attack options that required neither traditional air superiority as a prerequisite nor electronic-warfare and fighter-escort support. As a result, planners had a far greater array of options available to them than would have been the case with conventional aircraft. In this connection, the difference between the operations of Proven Force—which relied exclusively on conventional aircraft using unguided munitions—and the operations of rest of the air campaign operating from areas south, west, and east of Iraq is instructive. The Proven Force attacks looked more like the traditional "roll-back" efforts of previous campaigns, in which attacks on air defenses proceeded from the enemy's perimeter inward.

Beyond Visual Range (BVR) Shots

Desert Storm was the first major air campaign in which a sizable portion (over forty percent) of the air-to-air engagements that produced kills began with beyond-visual-range (BVR) missile shots. Here, the limit was less technology (although improved long-range radar-guided missiles helped) than command and control. In the past, fears of air-to-air fratricide had inhibited the use of long-range missiles fired BVR. The overwhelming superiority of Coalition air and Iraq's conservative air doctrine meant that the Iraqi Air Force did not rise to fight very much. When it did, however, Coalition aircraft making use of information gathered by Airborne Warning

and Control System (AWACS) aircraft could shoot safely at opponents that they could not see, or not see well.

Air Power's Dominance of the Iraqi Field Army

The duration, intensity, and military effectiveness of the thirty-nine days of air operations that preceded the Coalition ground offensive on 24 February undoubtedly exceeded anything that the Iraqi leaders foresaw, based on their experience during the Iran-Iraq war. The Iraqi Army's one attempt, in late January 1991, to move out into the open and precipitate the kind of bloody, close combat on the ground that Iraqi strategists believed would achieve important political, if not military, results succumbed swiftly to Coalition air power. Unlike the previous wars, air power operated almost as effectively at night as during the day, and in some cases more so. Unable to attack or retreat in the face of Coalition air power, the Iraqi Army in the Kuwait theater after Al Khafji could only hunker down and continue to suffer mounting punishment, both physical and psychological, from the air. When the Coalition's ground attack finally came, the ground forces of the U.S.-led alliance were able to destroy or expel from Kuwait the Iraqi divisions there in a scant one hundred hours of operations with extraordinarily low combat casualties. Indeed, the magnitude of what Gen. H. Norman Schwarzkopf asked Coalition air power to accomplish against Iraq's army in the Kuwait theater was astonishing by virtually any standard: to destroy fifty percent of the Iraqi armor and artillery in the Kuwait theater *before* Coalition ground forces engaged. The fact that Coalition air forces fell somewhat short of this ambitious goal in the case of some Republican Guard and other units should not detract from what they accomplished overall in the Kuwait theater. In the case of Iraqi front-line divisions, the fifty percent attrition equipment levels were not only met but, in some areas, exceeded.

Whether this remarkable outcome presages a new relationship between air forces and ground forces will, no doubt, be debated for years to come. Certainly, the success of air power ran contrary to the expectations of many experts in the United States before the war. The kill rates achieved against dug-in armor proved unprecedented. Air power had had successes against armor on the move in past wars, but in Desert Storm, the combination of rotary- and fixed-wing aircraft operating against forces on the move proved devastating. To be sure, given the mitigating effects of political circumstances, training, technology, geography, and force ratios that heavily favored the Coalition, some caution is indicated. We may require a sterner test against a more capable adversary to come to a conclusive judgment. But if air power again exerts similar dominance over opposing ground

forces, the conclusion will be inescapable that some threshold in the relationship between air and ground forces was first crossed in Desert Storm.

Operational Concepts and Organizational Adaptation

The general absence of new operational concepts for the use of air power in this war suggests that if a revolutionary change in the conduct of war is under way, the harder parts of its implementation may still lie in the future. To a surprising extent, the master attack plan/air tasking-order process used by the air planners and commanders in Riyadh merely modified an approach long used within NATO; it also bore a striking family resemblance to the way in which American planners had constructed and executed air campaigns as far back as World War II. Although staffs made improvised use of computers for word processing, construction of databases, and record-keeping, planners appear to have made surprisingly extensive use of pencils and yellow legal pads for their work. On the whole, the Coalition had not automated the extremely complicated tasks of developing force packages and air tasking orders and monitoring bomb damage nearly as much as those who speak of a military technical revolution would expect.

Concerning organizational innovation, the Black Hole planning group in Riyadh was an ad hoc organization staffed largely by outsiders. It disappeared at the end of the war, as has the wartime version of Checkmate. No organizational structure capable of operating as a genuine reconnaissance-strike complex existed, even though, as has been noted, most of the military systems needed for such a complex were present in the theater, and some swift attacks based on JSTARS information did occur. Imaging the kind of organization and doctrinal context necessary for a true reconnaissance-strike complex is not easy. In fact, our present situation regarding such strike complexes may be analogous to trying to imagine a 1940 *Panzer* division and its associated operational culture from the vantage point of 1922 or 1923.

One large organizational innovation that did occur-unforeseen and by force of circumstances-was the dispersion of much command and control activity outside the theater. Officers in the basement of the Pentagon helped pick targets and plan attacks; staffs at Langley Air Force Base in Virginia managed CENTAF's spare parts accounts; Space Command provided warning of missile attacks against Israel and Saudi Arabia; meteorologists in the United States processed weather information for use within the theater. From the outset, the civilian and military leadership of the American high command declared its strong desire that direction of this war should rest in

the hands of the theater commander in chief. By and large it did, but the dependence of modern military organizations on vast amounts of information, and the relative ease with which communications technology could disseminate that information, meant that supporting authority would, in some measure, trickle out of the theater. Now, commanders could tap the expertise of large staffs and organizations thousands of miles away to formulate decisions on courses of action to take during the next few hours. The formal scheme of organization did not acknowledge this, but the command system soon depended on informal arrangements and ad hoc groupings. The prevalence of such organizations may prove part of a broader trend and not merely an aberration.

The rapid collection, processing, and exploitation of information is likely to become even more important in future war than it has been in the past. In this regard, access to space-based sensors and location/navigation systems provided the Coalition yet another one-sided advantage throughout Desert Shield and Desert Storm, a condition that may not necessarily be repeated in future conflicts. This may, for example, be the last war in which only one side will have ready access to precise location information from satellites. It may also be the last occasion on which air supremacy could shield a moving army from an enemy's prying eyes; observation from space and the proliferation of remotely piloted vehicles could deny the benefit that XVIII Airborne Corps and VII Corps had in their swing to the west of Iraqi positions. In future warfare, the struggle for information may play a central role, taking the place, perhaps, that the contest for geographical position has held in previous conflicts. In Desert Storm, the effective operational-strategic employment of precision systems such as the F-117-GBU-27 combination required correspondingly precise target information, whereas the areas in which the strategic portion of the air campaign was least effective were precisely those in which fundamental gaps in Coalition understanding of entire target systems existed. While the Coalition unquestionably achieved the requisite "information dominance" against electricity, the nervous system of Iraq's air defense system, and the Iraqi Air Force in air-to-air combat, the evidence suggests that the Iraqis were able to deny the Coalition crucial information about their nuclear weapon and ballistic missile programs.

The Political Dimension

Just as important as the operational thresholds crossed in this war were the political thresholds, among them heightened Western sensitivity to casualties, both friendly and enemy. The phrase "no target is worth an

airplane" (a dictum that did not hold if it came to supporting troops in contact with the enemy on the ground or rescuing a downed pilot) captured an attitude toward losses that prevailed during the war. The cessation of daylight attacks against Baghdad targets following the loss of two F-16s on 19 January and the withdrawal of A-10s from attacks against the Republican Guard following the loss of two on 15 February revealed a sensitivity to loss having few precedents in American military history.¹⁶

The degree of concern about enemy losses, though less strong, was nonetheless pronounced. Including some 300 deaths reported by the Iraqis to have occurred when the Al Firdos bunker was bombed, the Iraqis themselves claimed fewer than 2,300 civilian dead despite the intensity and scope of the 43-day air campaign.¹⁷ Regarding collateral damage, American peace activists who visited Iraq immediately after the war looking for evidence that Baghdad had been razed by Coalition bombing instead found "a city whose homes and offices were almost entirely intact, where electricity was coming back on and the water was running."¹⁸ In fact, even Iraqi combat deaths seem to have been remarkably low. While the Survey concluded that total Iraqi combat fatalities over the 43 days of Desert Storm were higher than the estimate of 9,500 one observer has recently made,¹⁹ it seems clear that although Coalition forces waged high-intensity combat, including extensive bombing of

¹⁶In interview after interview conducted by GWAPS personnel with military participants in the Gulf War, the "lesson" that the low casualties experienced in Desert Storm established a "norm" that the U.S. military will have to meet in future wars was virtually universal.

¹⁷William M. Arkin, Greenpeace International, briefing to GWAPS, 31 Oct 1991.

¹⁸Erika Munk as cited in John G. Heidenrich, "The Gulf War: How Many Iraqis Died?", *Foreign Policy*, Spring 1993, p 118. Munk's conclusion that "Baghdad wasn't razed" is from an article in the May 1991 issue of *Nation*.

¹⁹Heidenrich, "The Gulf War: How Many Iraqis Died?", p 123. The Survey's best estimate, based primarily on enemy prisoner of war reports, is that Coalition air power killed some 10-12,000 Iraqi military in the Kuwait theater prior to the ground war. Available data did not permit a serious estimate of the number of Iraqi soldiers killed there during the 100-hour ground war. However, that total, which could easily have been as high as 10,000, would have to be added to the total for the first 39 days of the campaign. Iraqi personnel losses in the KTO are also covered in sections 4-6 of a forthcoming RAND (S/NIF/WN) rpt, by Stephen T. Hosmer, MR-305-AF, "Effects of the Coalition Air Campaign Against Iraqi Ground Forces." Much evidence gathered after the war has consistently indicated that relatively few Iraqi soldiers died during the 100-hour ground war (see, for example, George Kuhn, "Numbers from Combat," *Phalanx*, Jun 1993, p 22).

strategic targets throughout Iraq and heavy attacks against Iraqi ground forces, enemy casualties remained relatively low.

The trend toward "bloodlessness" as a desideratum in the conduct of war may have gained impetus from the growth in television reporting of combat operations via satellite. Cable News Network (CNN) reporting of the initial Coalition attacks on Baghdad while they were in progress remains one of the most vivid images from the Gulf War. Television coverage may have influenced political-military decisionmaking during the Gulf War, although some senior participants in White House decision-making discount this.²⁰ Careful review of the timing of media coverage of Coalition air attacks against Iraqi forces fleeing northward from Kuwait City along Highway 6 at the end of the war, for example, indicates that most of it appeared *after* President Bush had announced his decision to end hostilities on the evening of 27 February 1991 (Washington time). Transcripts indicated that there was no television coverage of the "Highway of Death" on the evening news programs from the three broadcast networks on the evenings of 25, 26, or 27 February. In fact, the only public indication preceding Bush's announcement that the Coalition might be inflicting "wanton" slaughter on fleeing Iraqi forces consisted of print coverage such as the "'Like Fish in a Barrel,' US Pilots Say" article that appeared in *The Washington Post* on the morning of 27 February.²¹

On the other hand, General Schwarzkopf reported that late in the afternoon of 27 February Riyadh time (which would have been early in the morning of the same day in Washington, D.C.), Gen. Colin Powell called to say that the two of them needed to discuss a cease-fire because people in Washington were getting nervous about all of the damage that Central Command's forces were inflicting on the Iraqis.²² The episode suggests the

²⁰See Walter Goodman, "How Bad Is War? It Depends on the TV Pictures," *The New York Times*, 5 Nov 1991, p C18.

²¹Richard Randall, "'Like Fish in a Barrel,' US Pilots Say," *The Washington Post*, 27 Feb 1991, p A28. The Randall article, which was based on reporting from aboard the USS *Ranger*, provided perhaps the most vivid account of air attacks against retreating Iraqi ground forces. However, one of *The Washington Post*'s front-page articles on the war that morning also echoed Randall's reporting from the *Ranger*. This front-page piece depicted Coalition air attacks on Iraqi armor and truck columns as "a combat frenzy variously described as 'a turkey shoot' and 'shooting fish in a barrel.'" (Rick Atkinson and William Claiborne, "Allies Surround Republican Guard, Say Crippled Iraqis Are Near Defeat," *The Washington Post*, 27 Feb 1991, p A1).

²²Gen H. Norman Schwarzkopf, with Peter Petre, *It Doesn't Take a Hero* (New

ways in which decisionmakers may find themselves considering not only *actual* media coverage of events such as the air attacks on Iraqis trying to flee the Kuwait theater but *anticipated* coverage of such activities. The principle here—that political considerations permeate war—is old, but the acute predicament implicit in satellite coverage is relatively new.

Conclusion

Did Desert Storm constitute a revolution in the nature or conduct of war? At a distance of two years and after careful scrutiny of the evidence, some of the aspects of the war that seemed most dramatic at the time appear less so than they did in the immediate afterglow of one of the most one-sided campaigns in military history. Despite the talk of Iraq possessing the fourth largest army in the world, the fact remains that in this war a minor power found itself confronted by the full weight of the world's sole superpower, amply and ably aided by the forces of its key allies. While the overall outcome—the ejection of Iraqi forces from Kuwait—was likely from the moment the war began, the cost and longer term consequences were not.

True revolutions in war may take decades and require not merely new technologies but new forms of organization and behavior to mature. It is probably too soon to conclude without reservation that we have entered a new era of warfare. But as we consider the war, some signposts of change surely stand out. Military planners and organizations will wish to reflect on the undoubted departures made during the Gulf War for some time to come. But whether the signposts identified here really point down paths very different from those the armed forces of the United States have been down before will depend on the future actions of the travellers themselves. The ingredients for a transformation of war may well have become visible in the Gulf War, but if a revolution is to occur someone will have to make it.

A Note on Sources

Most of the paper and electronic records used by the Gulf War Air Power Survey (GWAPS) are available to researchers with appropriate clearances at the United States Air Force Historical Research Agency (AFHRA), Maxwell Air Force Base, Alabama. The agency began to accumulate Gulf War records before the Survey was established in Washington during the summer of 1991. Early in Desert Shield, the Air Force deployed more than thirty enlisted historians under Chief Master Sergeant John R. Burton to the theater, where they collected documents, conducted interviews, and drafted unit historical reports. More than five hundred rolls of agency microfilm reached the Survey during its research phase, and a thousand rolls were available by the end of the writing phase. Agency microfilmmers shot the first hundred rolls in Riyadh, the second hundred at Langley Air Force Base, Virginia (headquarters of Tactical Air Command and CENTAF Rear), and the rest at Maxwell.

During the Vietnam War, the Air Force had begun the practice of microfilming paper records in the field to insure their preservation, but the Service did not meet with as much success in preserving the electronic records of that war. Since then electronic records have grown rapidly in quantity and importance. The Survey gathered a large collection of electronic records, many of which have been integrated in the three principal Survey databases: the missions database, the sortie database, and the target database. When the Survey was established, work on these databases was already underway at Langley Air Force Base. The chief of Langley's Gulf War database team, Maj. Lewis "Dough" Hill, moved the project to the Survey, where his team's work was the foundation of the statistics report, *Statistical Compendium*.

The target database permits researchers to determine quickly whether a potential target appeared on any of several intelligence or planning lists. The sortie database gives researchers information on Coalition sorties, both attack and support; this database was introduced in Riyadh by Maj. Roy Lee of the Tactical Air Control Center. Most of the Survey's database development effort has been expended on the missions database, which attempts to pull together all available

information about strikes on targets. The Survey counts as a single "strike" one aircraft delivering any number of munitions against a single target on one sortie. If four aircraft bomb a target, that is counted as four strikes. If one aircraft bombs two targets on a single sortie, that is counted as two strikes. In addition to its utility in building cumulative statistics on Coalition air attacks, the missions database enables a researcher to learn when a particular target was struck by particular aircraft and munitions; damage assessments are included.

The missions database relies heavily on the mission report messages saved by a CENTAF intelligence computer, the Limited Enemy Situation/Correlation (LENSCE) message processor. The Survey was disappointed to learn that information storage devices associated with operations computers in the theater were reused after thirty days, wiping out much of the electronic record of the war. Fortunately, some of that electronic record was preserved by LENSCE. While most mission report messages were saved only electronically, the Survey obtained a large volume of other printed messages (many of which were not saved electronically). These comprise about a third of more than 500,000 of the Survey's paper records.

The Survey's archive of paper records is divided into four sets: (1) records of CENTAF's Black Hole planning group (2) records of the Air Staff's Checkmate planning group (3) records of the Air Staff's Operations Center, and (4) new acquisitions. The first three sets came to GWAPS at the outset and are maintained in the filing systems of the organizations that created them. New acquisitions include the reports of other agencies studying the Gulf War as well as wartime records subsequently acquired by Survey researchers. Many footnotes in the Survey's reports cite these records, using the identifiers listed below:

GWAPS File Series Abbreviations

Black Hole Files BH

Checkmate Historian's Files

Desert Shield	CHSH
Desert Storm	CHST
Planners	CHP

Chain of Command	CHC
Overviews	CHO
Video, Audio	CHV
Target Photos	CHT
Special Compartmented Information ..	CHSCI

Checkmate Office Files

Central	CC
ATO	CATO
BDA	CBDA
Intelligence	CI
Gulf War Office	CG

Hq USAF Operations Center Files

Contingency Operations Branch	COB
Contingency Support Staff	CSS

New Acquisitions File NA

GWAPS CHSH 100-29 indicates the twenty-ninth document in the hundredth folder in the Checkmate Historian's File on Desert Shield. GWAPS NA 6 indicates the sixth folder in the New Acquisitions file. Air Force Historical Research Agency microfilm records are referenced by AFHRA followed either by a six-digit computer index (IRJS) number or a five-digit roll number.

The Air Force Historical Research Agency is cataloging GWAPS paper records to allow electronic retrieval through IRIS but the Agency will retain a cross-reference to the original GWAPS identifiers. Automated finding aids helped the Survey to begin studying the large body of records on the Gulf War, but much remains to be done. Survey reports should themselves be seen as finding aids for those who will continue the study of this war.

Glossary

AAA	Antiaircraft Artillery
AAR	After Action Report
AB	Air Base
ABCCC	Airborne Battlefield Command and Control Center
Abn Corps	Airborne Corps (US)
AFB	Air Force Base
AFHRA	Air Force Historical Research Agency
AI	Air Interdiction
AIF	Automated Installation-Intelligence File
ALARM	Air-Launched Anti-Radiation Missile
ANG	Air National Guard
AOR	Area of Responsibility
ARCENT	U.S. Army Forces, Central Command
ATACMS	Army Tactical Missile System
ATO	Air Tasking Order
AWACS	Airborne Warning and Control System
BDA	Bomb Damage Assessment
BE or BEN	Basic Encyclopedia Number
BVR	Beyond Visual Range
BW	Biological Warfare
C3	Command, Control, and Communications
CAFMS	Computer Assisted Force Management System
CALCM	Conventional Air-Launched Cruise Missile

CAP	Combat Air Patrol
CAS	Close Air Support
CBU	Cluster Bomb Unit
CEM	Combined Effects Munition
CENTAF	Air Force Component, Central Command
CENTCOM	U.S. Central Command
CES	Civil Engineering Squadron
CIA	Central Intelligence Agency
CINC	Commander-in-Chief
CINCCENT	Commander-in-Chief, Central Command
CJCS	Chairman, Joint Chiefs of Staff
CNN	Cable News Network
COMUSCENTAF	Commander, U.S. Air Force Component, Central Command
CRAF	Civil Reserve Air Fleet
CSAR	Combat Search and Rescue
CVBG	Aircraft Carrier Battle Group (USN)
D-Day	Unnamed day on which an operations begins
DIA	Defense Intelligence Agency
Div	Division
DMAAC	Defense Mapping Agency Aerospace Center
DMPI	Desired Mean Point of Impact
DOD	Department of Defense
DSB	Defense Science Board
ECM	Electronic Countermeasures

EMIS	Electro-Magnetic Isotope Separation
EPW	Enemy Prisoner of War
FAC	Forward Air Control
FLIR	Forward-Looking Infrared
FLOGEN	Flow Generation computer model
FSCL	Fire Support Coordination Line
GWAPS	Gulf War Air Power Survey
G-Day	Day the ground war began
HARM	High-Speed Antiradiation Missile
HAB	Hardened Aircraft Bunker
HAS	Hardened Aircraft Shelter
IFF	Identification Friend or Foe
IIR	Intelligence Information Report
IOC	Intercept Operations Center
IR	Infrared
IRIS	AFHRA Computer Indexing System
J-2	Intelligence Directorate (Joint)
Jaguar	Land-based ground attack aircraft
JCS	Joint Chiefs of Staff
JDOP	Joint U.S./Saudi Directorate of Planning
JFACC	Joint Force Air Component Commander
JFC-E	Joint Forces Command East
JFC-N	Joint Forces Command North
JIC	Joint Intelligence Center
JMEM	Joint Munitions Effectiveness Manual

JOPES	Joint Operations Planning and Execution System
JSTARS	Joint Surveillance Target Attack Radar System (E-8)
JTF	Joint Task Force
JULL	Joint Uniform Lessons Learned
KKMC	King Khalid Military City
KIA	Killed In Action
KTO	Kuwait Theater of Operations
LAMPS	Light Airborne Multi-Purpose System (USN)
LANDSAT	Land Satellite, NASA/NOAA Satellite Program
LANTIRN	Low Altitude Navigation and Targeting Infrared System for Night
LGB	Laser-Guided Bomb
LOC	Lines of Communication
MAC	Military Airlift Command
MAGTF	Marine Air Ground Task Force
MAJCOM	Major Command
MAP	Master Attack Plan
MARCENT	U.S. Marine Corps, Central Command
MEB	Marine Expeditionary Brigade
Mech Div	Mechanized Infantry Division
MEF	Marine Expeditionary Force
MEL	Mobile Erector Launcher used for mobile missiles
MLRS	Multiple Launch Rocket System
MPS	Maritime Prepositioning Squadron

NATO	North Atlantic Treaty Organization
NAVCENT	Naval Component, Central Command
NBC	Nuclear, Biological, and Chemical
NCA	National Command Authorities
NF or NOFORN	Not Releasable to Foreign Nationals
NIE	National Intelligence Estimate
OASD	Office of the Assistant Secretary of Defense
OCA	Offensive Counter Air
OPLAN	Operation Plan
OPORD	Operation Order
OSD	Office of the Secretary of Defense
PACAF	Pacific Air Forces
PGM	Precision-Guided Munition
POL	Petroleum, Oils and Lubricants
POW	Prisoner of War
PSYOPS	Psychological Operations
RAF	Royal Air Force (U.K.)
RCAF	Royal Canadian Air Force
RGFC	Republican Guard Force Command (Iraq)
ROE	Rules of Engagement
RPV	Remotely Piloted Vehicle
RSAF	Royal Saudi Air Force
RSLF	Royal Saudi Land Force
SAC	Strategic Air Command
SAD	Strategic Air Defense
SAM	Surface-to-Air Missile

SANG	Saudi Arabian National Guard
SCUD	Soviet-made surface-to-surface missile
SCI	Sensitive Compartmented Information
SEAD	Suppression of Enemy Air Defenses
SECDEF	Secretary of Defense
SNIE	Special National Intelligence Estimate
SOC	Sector Operations Center
SOCCENT	Special Operations Command, Central Command
SOCOM	Special Operations Command
SOF	Special Operations Forces
SPEAR	Strike Projection Evaluation and Anti-Air Warfare Research (USN)
SPG	Special Planning Group
SPINS	Special Instructions
STU	Secure Telephone Unit
SWA	Southwest Asia
TAC	Tactical Air Command
TACAIR	Tactical Air
TACC	Tactical Air Control Center
TACS	Tactical Air Control System
TACSAT	Tactical Satellite
TALD	Tactical Air-Launched Decoy
TARPS	Tactical Air Reconnaissance Pod System
TEL	Transporter Erector Launcher
TEMPER	Tent Expendable Modular Personnel
TFS	Tactical Fighter Squadron

TFW	Tactical Fighter Wing
TIALD	Thermal Imaging and Laser Designating
TIS	Tactical Intelligence Squadron
TLAM	Tomahawk Land-Attack Missile
TOT	Time Over Target
TPFDD	Time-Phased Force Deployment Data
UAV	Unmanned Aerial Vehicle
UK	United Kingdom
UN	United Nations
USAF	United States Air Force
USAFE	U.S. Air Forces Europe
USCENTCOM	Central Command
USCINCCENT	Commander-in-Chief U.S. Central Command
USMC	U.S. Marine Corps
USN	U.S. Navy
USNAVCENT	U.S. Naval Component, Central Command
USSOCOM	U.S. Special Operations Command
WRSK	War Readiness Spares Kits

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